

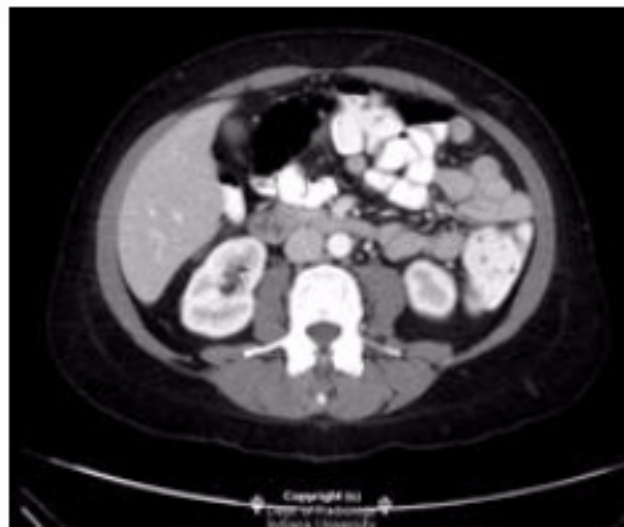


Our appreciation is extended to Dr. Nicholas Koontz,
Indiana University Department of Radiology,
for contributing this case.



History: A 50-year-old woman presents with pain.

CT images are shown below. Click to enlarge.





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Which choice best localizes the most salient abnormality?

☐ Stomach

☐ Pancreas

☐ Mesentery

☐ Cecum

☐ Extrapertitoneal space

The question above accounts for 33% of your total score for this case.

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Which choice best localizes the most salient abnormality?

☐ Stomach

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☐ Mesentery

☐ Cecum

☒ Extraperitoneal space (correct!)

The question above accounts for 33% of your total score for this case.

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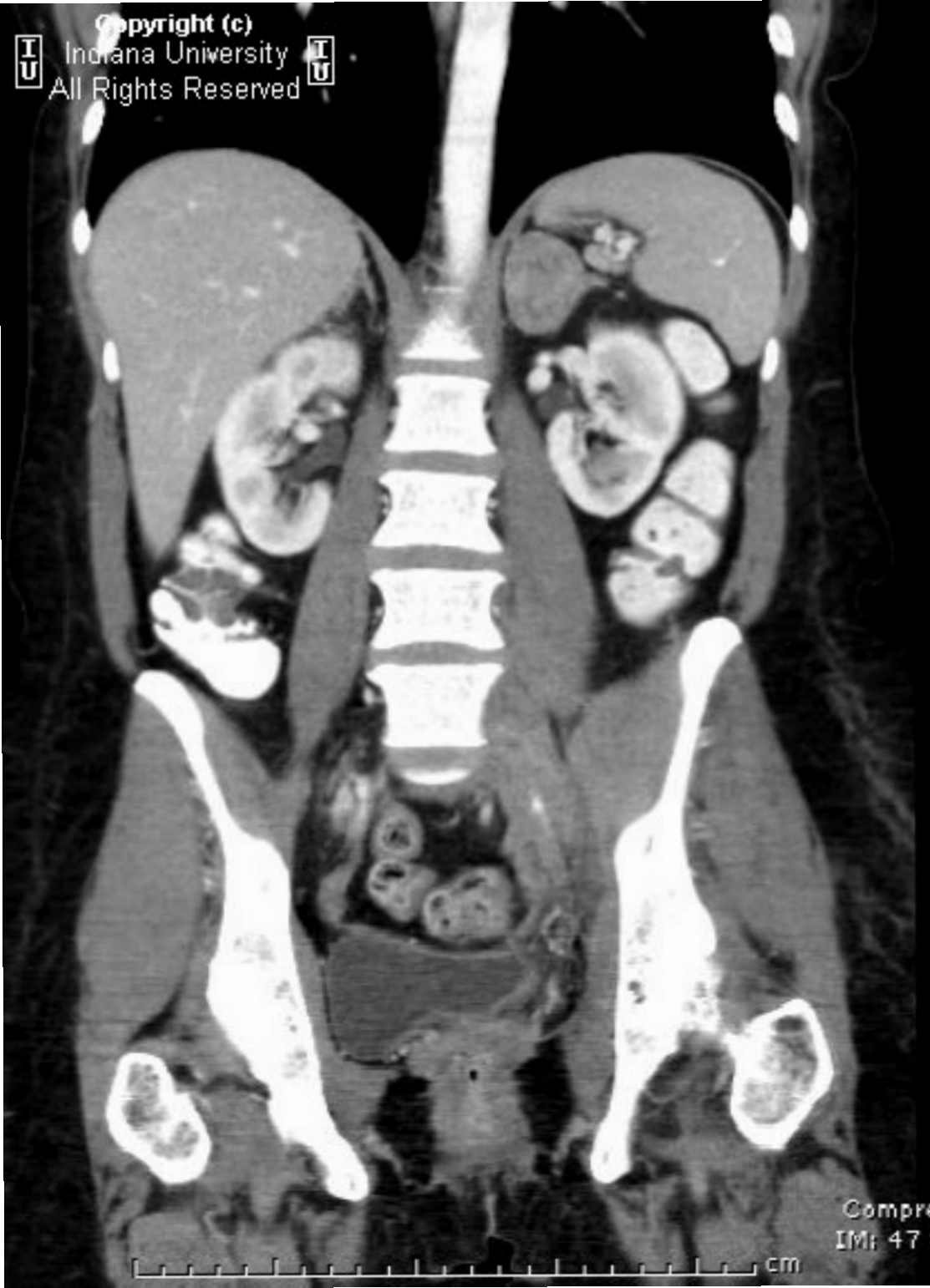
Additional images

Additional CT images that focus on the abnormal area are shown below. Click to enlarge.











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cm



Which choice most likely characterizes the underlying process?

☐ Inflammatory/fibrotic

☐ Neoplastic

☐ Infectious

☐ Post-traumatic

☐ Vascular pathology

The question above accounts for 33% of your total score for this case.

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The question above accounts for 33% of your total score for this case.

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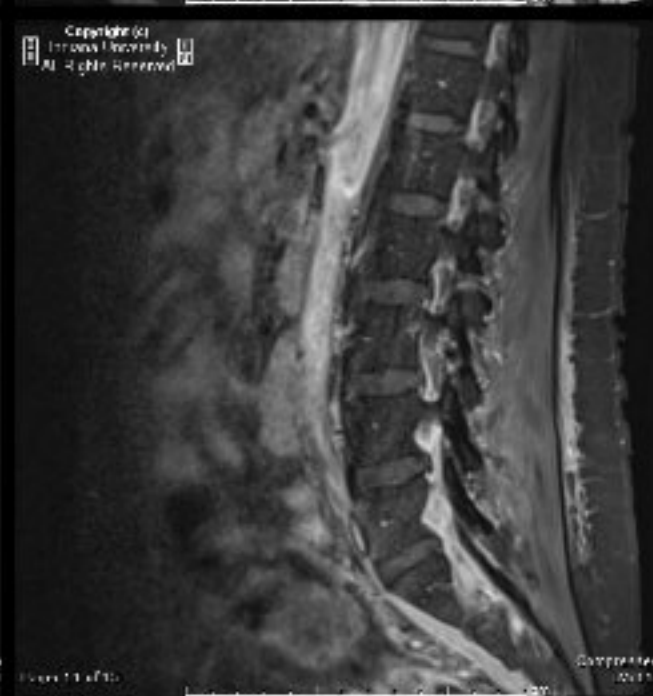
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What is the diagnosis?

- ☐ Leukemia
- ☐ Ewing's sarcoma
- ☐ Lymphoma
- ☐ Plasmacytoma
- ☐ Histoplasmosis

The question above accounts for 34% of your total score for this case.

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What is the diagnosis?

☒ Leukemia (correct!)

☐ Ewing's sarcoma

☐ Lymphoma

☐ Plasmacytoma

☐ Histoplasmosis

[Explain this Answer]

The question above accounts for 34% of your total score for this case.

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What is the diagnosis?

☒ Leukemia (correct!)

☐ Ewing's sarcoma

☐ Lymphoma

☐ Plasmacytoma

☐ Histoplasmosis

[Explain this Answer]

The question above accounts for 34% of your total score

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This turned out to be acute myelogenous leukemia (bone marrow biopsy-proven) with granulocytic sarcoma involving the lumbar spine and pelvis.

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Findings

- **CT of the abdomen and pelvis:**
 - There is a left extraperitoneal soft-tissue mass extending from the pelvic brim along the left iliopsoas muscle, encasing the left external and internal iliac vessels with near complete obliteration of the left iliac venous lumen.
 - The enhancing soft-tissue mass appears to extend into the spinal canal at the lumbosacral junction with enhancement extending along the dura.
 - No evidence of underlying bone destruction of the sacrum or the lumbar spine.
 - There is also an incidental, stable left adrenal adenoma.
- **MRI of the lumbar spine:**
 - MRI demonstrates a T1/T2-hypointense, infiltrative, enhancing soft-tissue mass involving the left hemipelvis extending into the anterior and left lateral epidural space from L4/L5 to the S1 level, the left paravertebral soft tissues, and the medial aspects of the left psoas and iliacus muscles.
 - The mass encases the left L4 and L5 exiting nerve roots, as well as the left L5 and S1 descending nerve roots.
 - Diffuse T1 hypointensity of the visualized thoracolumbar spine is seen.

Differential diagnosis

- Leukemia with chloroma (granulocytic sarcoma)
- Metastatic disease
 - Children: neuroblastoma, Ewing's sarcoma, eosinophilic granuloma, rhabdomyosarcoma, and primitive neuroectodermal tumor (PNET)
 - Adults: usually carcinomas
- Langerhans cell histiocytosis
- Lymphoma

left L5 and S1 descending nerve roots.

- Diffuse T1 hypointensity of the visualized thoracolumbar spine is seen.

Differential diagnosis

- Leukemia with chloroma (granulocytic sarcoma)
- Metastatic disease
 - Children: neuroblastoma, Ewing's sarcoma, eosinophilic granuloma, rhabdomyosarcoma, and primitive neuroectodermal tumor (PNET)
 - Adults: usually carcinomas
- Langerhans cell histiocytosis
- Lymphoma
- Hematoma
- Osteomyelitis/abscesses (pelvic, paraspinous, and epidural)
- Ewing's sarcoma
- Plasmacytoma
- Malignant fibrous histiocytoma

Diagnosis: Acute myelogenous leukemia (bone marrow biopsy-proven) with granulocytic sarcoma involving the lumbar spine and pelvis

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Discussion

Granulocytic sarcoma (also known as extramedullary myeloblastoma) is a rare solid tumor consisting of precursors of the granulocytic line of white blood cells (i.e., myeloblasts, promyelocytes, and myelocytes). This lesion is more frequently referred to as a chloroma, due to the frequently green color of the lesions due to high concentrations of myeloperoxidase. The name "chloromas" is somewhat of a misnomer, as up to one-third of these lesions are not green, and they may appear white, gray, or brown at the time of pathology inspection. This is thought to be due to variable concentrations of myeloperoxidase in these lesions.

Granulocytic sarcomas are associated with acute myelogenous leukemia (AML), chronic myelogenous leukemia (CML), myelofibrosis with myeloid metaplasia, hypereosinophilic syndrome, and polycythemia vera. They may occur at any time point during the leukemia or myeloproliferative disorder, including preceding it by several months. Granulocytic sarcoma may involve virtually any part of the body, including the orbits, subcutaneous tissues, paranasal sinuses, lymph nodes, bone, spine, brain, pleura, peritoneal cavity, breast, thyroid, salivary glands, lungs, mediastinum, and pelvic organs.

Granulocytic sarcoma is a rare condition and is reported in 2.5% to 9.1% of AML cases. It is five times as infrequent in CML. Men and women demonstrate equal incidence, and it is more common in children, with 60% of cases occurring in those younger than 15.

Patients are often asymptomatic, with up to 50% of cases reportedly diagnosed at

Granulocytic sarcoma is a rare condition and is reported in 2.5% to 9.1% of AML cases. It is five times as infrequent in CML. Men and women demonstrate equal incidence, and it is more common in children, with 60% of cases occurring in those younger than 15.

Patients are often asymptomatic, with up to 50% of cases reportedly diagnosed at the time of autopsy, although this number will likely decrease due to increased cross-sectional imaging. Symptoms are typically related to associated mass effect and are dependent upon location.

There is no prognostic significance between AML patients with and without granulocytic sarcoma, although patients with concomitant CML or myeloproliferative disorder and granulocytic sarcoma have a worse prognosis. In these cases, it often heralds the acute transformation or "blast crisis" phase of illness. Granulocytic sarcoma is frequently very sensitive to focal radiation and tends to respond better to focused radiation than systemic chemotherapy. Complete resolution in three months is often encountered, although up to 23% recurrence is quoted in the literature.

Radiologic overview of the diagnosis

In patients with leukemia and associated granulocytic sarcoma of the spine and pelvis, lesions are (as in this case) often first encountered on abdominal/pelvis CT. On noncontrast-enhanced CT, masses are isodense to slightly hypodense (with respect to muscle) and often demonstrate associated bone destruction. Additional findings may include an increased density of the lumbar theca and nerve roots, reflecting meningeal involvement. Variable enhancement is noted on contrast-enhanced CT.

MRI is the front-line imaging modality for evaluating granulocytic sarcoma. On T1-weighted imaging, leukemic marrow changes are characterized by hypointense signal. Chloromas also appear hypointense on T1-weighted imaging. Abnormal marrow, leptomeningeal, or focal mass enhancement is noted upon administration of intravenous contrast on T1-weighted sequences. On T2-weighted imaging, leukemic marrow changes are characterized by hyperintense signal. The mass may appear less conspicuous on this sequence, and associated cord signal abnormalities can be appreciated if present. On short tau inversion-recovery (STIR) sequence, hyperintense marrow changes are noted.

Occasionally, a nuclear medicine bone scan is employed for evaluating spinal involvement of leukemia. While increased radiotracer uptake may be seen, this modality tends to underestimate the extent of the disease.

In terms of initial imaging recommendations, MRI with intravenous contrast remains the diagnostic imaging gold standard.

Key points

- Granulocytic sarcoma (also known as chloroma, extramedullary myeloblastoma) is a rare soft-tissue mass associated with AML, CML, or sundry myeloproliferative disorders that may occur virtually anywhere in the body.
- Named for their green color (i.e., "chloroma"), up to a third of these lesions are not green at the time of pathology evaluation, likely due to varying concentrations of myeloperoxidase.
- While these lesions do not impart a worse prognosis in cases of AML, other myeloproliferative disorders (including CML) with concomitant granulocytic

In terms of initial imaging recommendations, MRI with intravenous contrast remains the diagnostic imaging gold standard.

Key points

- Granulocytic sarcoma (also known as chloroma, extramedullary myeloblastoma) is a rare soft-tissue mass associated with AML, CML, or sundry myeloproliferative disorders that may occur virtually anywhere in the body.
- Named for their green color (i.e., "chloroma"), up to a third of these lesions are not green at the time of pathology evaluation, likely due to varying concentrations of myeloperoxidase.
- While these lesions do not impart a worse prognosis in cases of AML, other myeloproliferative disorders (including CML) with concomitant granulocytic sarcoma have a worse prognosis. They may herald an acute transformation or "blast crisis."
- Presenting symptoms depend upon location of the tumor and are frequently the result of mass effect, as in this case. Up to 50% of cases are asymptomatic and are diagnosed at the time of autopsy, although this will likely decrease as cross-sectional imaging exams increase.
- MRI with IV contrast is the mainstay of radiologic diagnosis.
- Granulocytic sarcomas typically respond well to focused radiation therapy, with complete resolution often demonstrated in three months.
- A high recurrence rate of up to 23% is reported in the literature.

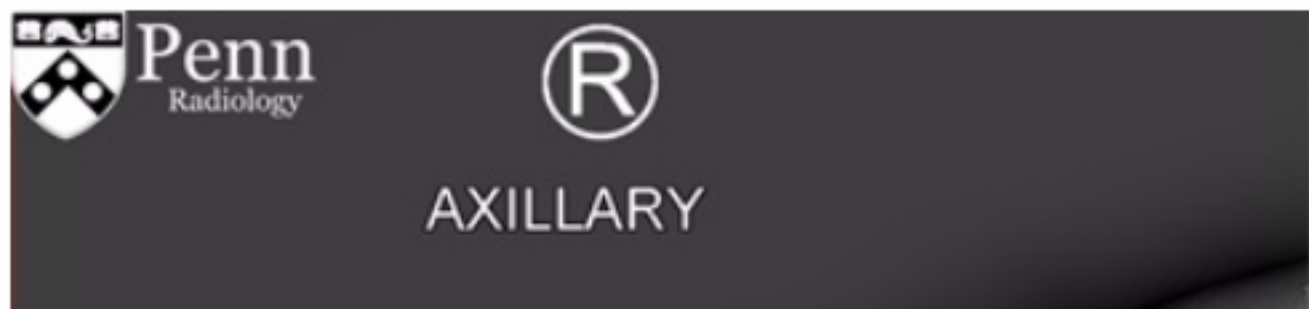
References

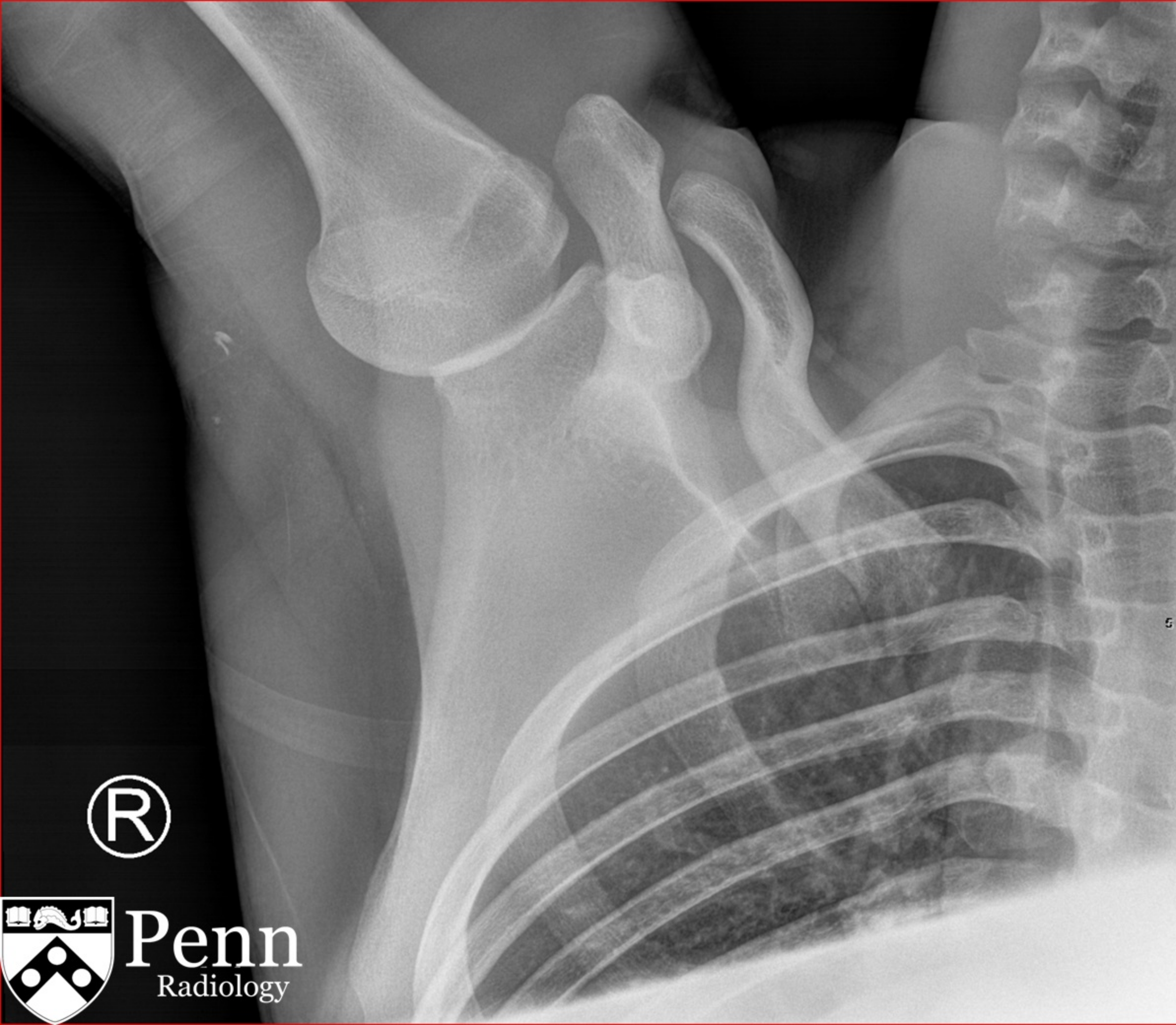
History and radiographs

Our appreciation is extended to Dr. Teresa Martin-Carreras, University of Pennsylvania Department of Radiology, for contributing this case.

History: An 18-year-old man presents to the emergency department with shoulder pain. He has a history of prior shoulder dislocations.

Shoulder radiographs are shown below. Click to enlarge.





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Which type of shoulder dislocation is seen?

☐ Anterior shoulder dislocation

☐ Inferior shoulder dislocation

☐ Posterior shoulder dislocation

The question above accounts for 20% of your total score for this case.

Pneumonia is incidentally seen in the provided radiographs.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

Which of the following findings also is present?

☐ Hill-Sachs lesion



Which type of shoulder dislocation is seen?

☐ Anterior shoulder dislocation

☒ Inferior shoulder dislocation (correct!)

☐ Posterior shoulder dislocation

The question above accounts for 20% of your total score for this case.

Pneumonia is incidentally seen in the provided radiographs.

☐ True

☒ False (correct!)

The question above accounts for 16% of your total score for this case.

Which of the following findings also is present?

☐ Hill-Sachs lesion

☒ False (correct!)

The question above accounts for 16% of your total score for this case.

Which of the following findings also is present?

☐ Hill-Sachs lesion

☐ Bony Bankart lesion

☐ Reverse bony Bankart lesion

☐ Reverse Hill-Sachs lesion

The question above accounts for 16% of your total score for this case.

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☒ False (correct!)

The question above accounts for 16% of your total score for this case.

Which of the following findings also is present?

☒ Hill-Sachs lesion (correct!)

☐ Bony Bankart lesion

☐ Reverse bony Bankart lesion

☐ Reverse Hill-Sachs lesion

The question above accounts for 16% of your total score for this case.

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Findings

There is an inferior glenohumeral joint dislocation with the arm in fixed abduction as confirmed by the emergency department physician. A posterolateral humeral head compression fracture also is noted in keeping with a Hill-Sachs lesion.

There are soft-tissue calcifications in the axilla. The visualized lungs are unremarkable.

Differential diagnosis

- Inferior glenohumeral joint dislocation
- Inferior humeral head subluxation
- Anterior glenohumeral shoulder dislocation

Diagnosis: Inferior glenohumeral joint dislocation (luxatio erecta)

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Additional questions

Inferior glenohumeral joint dislocation is the most common type of shoulder dislocation.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

This type of dislocation is often associated with a sensory deficit.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

Surgical reduction is often necessary for management

Additional questions

Inferior glenohumeral joint dislocation is the most common type of shoulder dislocation.

☐ True

☒ False (correct!)

The question above accounts for 16% of your total score for this case.

This type of dislocation is often associated with a sensory deficit.

☒ True (correct!)

☐ False

The question above accounts for 16% of your total score for this case.

Surgical reduction is often necessary for management

☐ False

The question above accounts for 16% of your total score for this case.

Surgical reduction is often necessary for management.

☐ True

☒ False (correct!)

The question above accounts for 16% of your total score for this case.

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Key points

Inferior glenohumeral joint dislocation

Pathophysiology

- Inferior glenohumeral joint dislocation, also known as luxatio erecta, is the least common form of shoulder dislocation.
- It typically occurs after a headfirst fall onto a fully abducted outstretched arm.
- The humeral head is forced against the acromion, usually resulting in inferior glenohumeral capsule rupture and rotator cuff disruption.
- Associated abnormalities include greater tuberosity, acromial, clavicular and coracoid fractures, rotator cuff tears, brachial plexus injury, axillary artery injury, and venous thrombosis.

Epidemiology

Inferior glenohumeral joint dislocation accounts for 0.5% to 1% of all shoulder dislocations.

Clinical presentation

- Patients typically present with shoulder pain, and the affected arm held between 110° and 160° of abduction.
- Patients will also often present with their hand placed on the head or close to it.

- Approximately 60% to 100% of patients have a sensory deficit.
 - Most deficits resolve after reduction.
 - It is usually a small patch over the deltoid muscle.

Imaging features

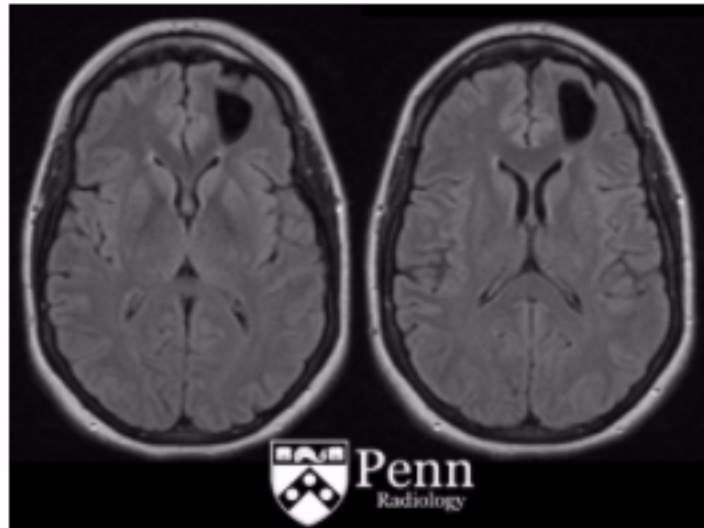
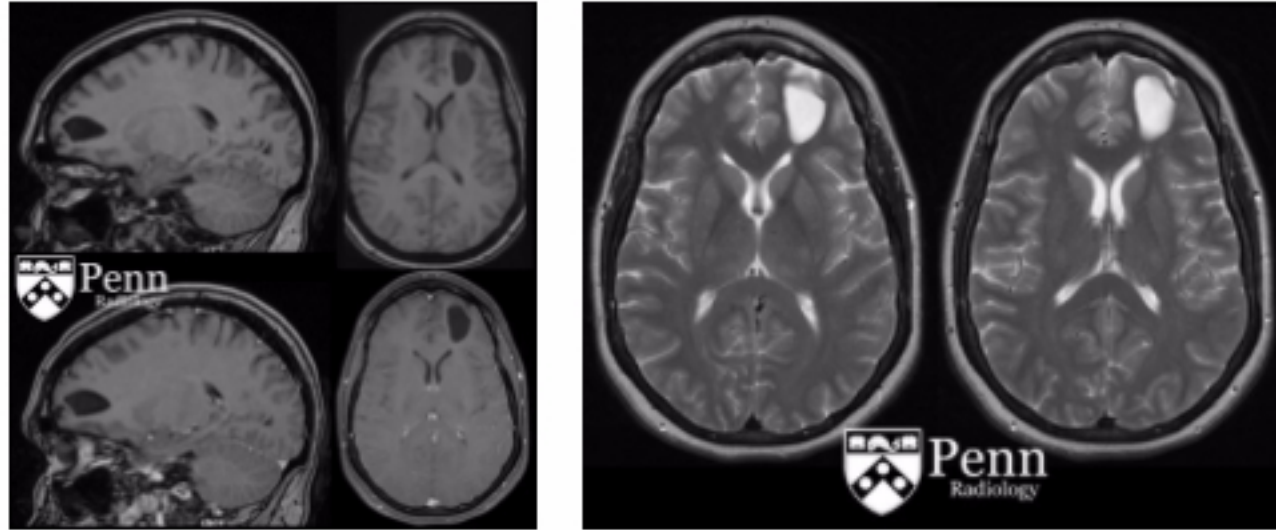
- Radiographs:
 - Humeral head is inferior and medial to the glenoid fossa on anteroposterior view.
 - Arm is in extreme abduction.
 - May see a displaced greater tuberosity fracture.
- MRI:
 - MRI is typically performed postreduction.
 - Common findings include rotator cuff tears, glenoid labrum injuries, injuries to the inferior glenohumeral ligament, and impaction fractures (i.e., Hill-Sachs lesion).

Treatment

- Immediate reduction is recommended to reduce the chance of long-term neurological injury.
- Surgical reduction may be necessary if the inferior capsule hole is too tight to reduce.
- Postreduction patients will be immobilized for a brief period, and this is typically followed by range of motion exercises.
- Physical therapy may be necessary in cases of brachial plexus injury.

History: A 75-year-old man presents with headaches.

Sagittal and axial T1 pre- and postcontrast, axial T2-weighted, and axial fluid-attenuated inversion-recovery (FLAIR) MR images are shown below. Click to enlarge.



A lesion is located in which of the following areas?

☐ Frontal lobe

☐ Temporal lobe

☐ Parietal lobe

☐ Occipital lobe

The question above accounts for 15% of your total score for this case.

The lesion contains which of the following signal characteristics?

☐ Mucin

☐ Blood

☐ Cerebrospinal fluid

The question above accounts for 15% of your total score for this case.

A lesion is located in which of the following areas?

☒ Frontal lobe (correct!)

☐ Temporal lobe

☐ Parietal lobe

☐ Occipital lobe

The question above accounts for 15% of your total score for this case.

The lesion contains which of the following signal characteristics?

☐ Mucin

☐ Blood

☒ Cerebrospinal fluid (correct!)

The question above accounts for 15% of your total score for this case.

There is some surrounding FLAIR signal abnormality.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

There is enhancement of the lesion.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

In which space is the lesion found?

☐ Subarachnoid

☐ Subpial

☐ Subdural

There is some surrounding FLAIR signal abnormality.

☐ True

☒ False (correct!)

The question above accounts for 14% of your total score for this case.

There is enhancement of the lesion.

☐ True

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☐ Subarachnoid

☐ Subpial

☐ Subdural

In which space is the lesion found?

☐ Subarachnoid

☐ Subpial

☐ Subdural

☒ Parenchymal (correct!)

The question above accounts for 14% of your total score for this case.

The lesion is most likely benign.

☒ True (correct!)

☐ False

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Arachnoid cyst

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

- ☐ Arachnoid cyst
- ☐ Dysembryoplastic neuroepithelial tumor
- ☐ Neuroglial cyst
- ☐ Pleomorphic xanthoastrocytoma

The question above accounts for 14% of your total score for this case.

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What is the most likely diagnosis?

- ☐ Arachnoid cyst
- ☐ Dysembryoplastic neuroepithelial tumor
- ☒ Neuroglial cyst (correct!)
- ☐ Pleomorphic xanthoastrocytoma

The question above accounts for 14% of your total score for this case.

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Findings

There is a simple, intra-axial cyst with smooth contours in the anterior left frontal white matter measuring up to 2.9 cm. There is no abnormal enhancement or surrounding parenchymal signal abnormality. There is no communication to the ventricle or superficial subarachnoid space.

Differential diagnosis

- Neuroglial cyst
- Dilated perivascular space
- Subarachnoid cyst
- Porencephalic cyst
- Neurocysticercosis
- Cystic neoplasm/low-grade gliomas
 - Dysembryoplastic neuroepithelial tumor
 - Pilocytic astrocytoma
 - Pleomorphic xanthoastrocytoma
 - Multinodular and vacuolating neuronal tumor
- Cystic periventricular leukomalacia

Diagnosis: Neuroglial cyst

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Discussion

Neuroglial cyst

Pathophysiology

Neuroglial cysts, also called gliependymal cysts, are benign epithelial-lined lesions that can be found anywhere along the neuroaxis. They can be extraparenchymal or intraparenchymal, that latter of which are more common. Intraparenchymal cysts are congenital lesions arising from embryonic neural tube elements sequestered in the developing white matter. They can be lined by either ependymal epithelium (columnar epithelium) or choroid plexus cells (low cuboidal epithelium). They do not communicate with the ventricular system or arachnoid space.

Epidemiology

They are uncommon, representing only 1% of intracranial cysts. They are usually found incidentally and do not cause any symptoms.

Imaging features

- Neuroglial cysts appear as round, smooth, unilocular cysts containing clear fluid.
- They can be seen anywhere, with the most common location being the frontal lobes.
- They are usually solitary (in contrast to dilated perivascular spaces).
- They follow cerebrospinal fluid signal characteristics on all sequences.
- They do not show abnormal enhancement.

Epidemiology

They are uncommon, representing only 1% of intracranial cysts. They are usually found incidentally and do not cause any symptoms.

Imaging features

- Neuroglial cysts appear as round, smooth, unilocular cysts containing clear fluid.
- They can be seen anywhere, with the most common location being the frontal lobes.
- They are usually solitary (in contrast to dilated perivascular spaces).
- They follow cerebrospinal fluid signal characteristics on all sequences.
- They do not show abnormal enhancement.
- They do not show restriction of diffusion.

Treatment

Neuroglial cysts are incidental, benign lesions that do not require treatment.

References

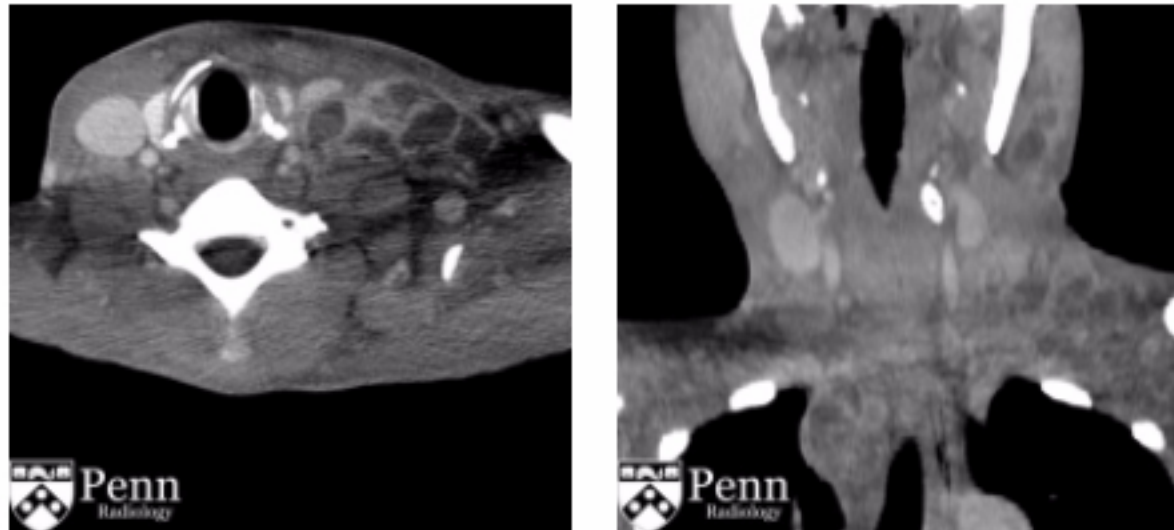
1. Epelman M, Daneman A, Blaser SI, Konen O, Jarrin J, Navarro OM. Differential diagnosis of intracranial cystic lesions at head US: Correlation with CT and MR imaging. *Radiographics*. 2006;26(1):173-196.
2. Osborn AG. Neuroglial cyst. In: Osborn AG, Salzman KL, Katzman G, et al, eds. *Diagnostic Imaging: Brain*. Salt Lake City, UT: Amirsys; 2004: 7-20.
3. Osborn AG, Preece MT. Intracranial cysts: Radiologic-pathologic correlation

History and CT images

Our appreciation is extended to Dr. Bryan Chang, PhD, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 46-year-old man presents to the emergency department (ED) with neck fullness and abdominal pain. The patient moved to the U.S. from Liberia 10 years ago. He was initially seen by his primary care physician and was sent to the ED directly from his primary care visit for further evaluation.

A contrast-enhanced CT scan of the neck was performed. Axial and coronal images are shown below. Click to enlarge.



The central low density within the lymph nodes suggests necrosis.

The central low density within the lymph nodes suggests necrosis.

☐ True

☐ False

The question above accounts for 13% of your total score for this case.

Which of the following should NOT be included in the differential diagnosis for chronic cervical lymphadenopathy?

☐ Infection

☐ Malignancy

☐ Autoimmune

☐ Granulomatous disease

☐ All of the above can cause chronic cervical lymphadenopathy

The central low density within the lymph nodes suggests necrosis.

☒ True (correct!)

☐ False

The question above accounts for 13% of your total score for this case.

Which of the following should NOT be included in the differential diagnosis for chronic cervical lymphadenopathy?

☐ Infection

☐ Malignancy

☐ Autoimmune

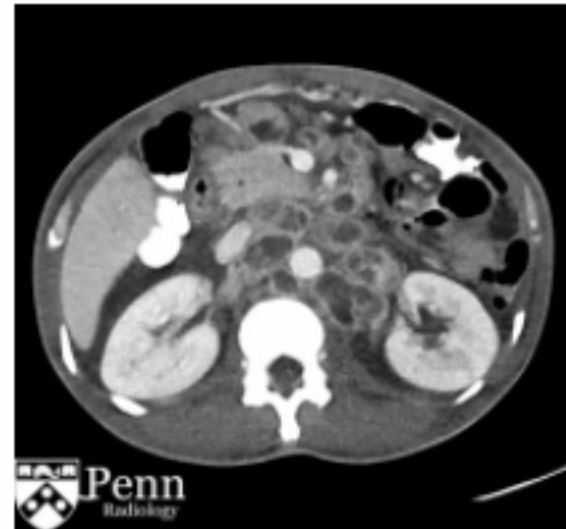
☐ Granulomatous disease

☒ All of the above can cause chronic cervical lymphadenopathy (correct!)

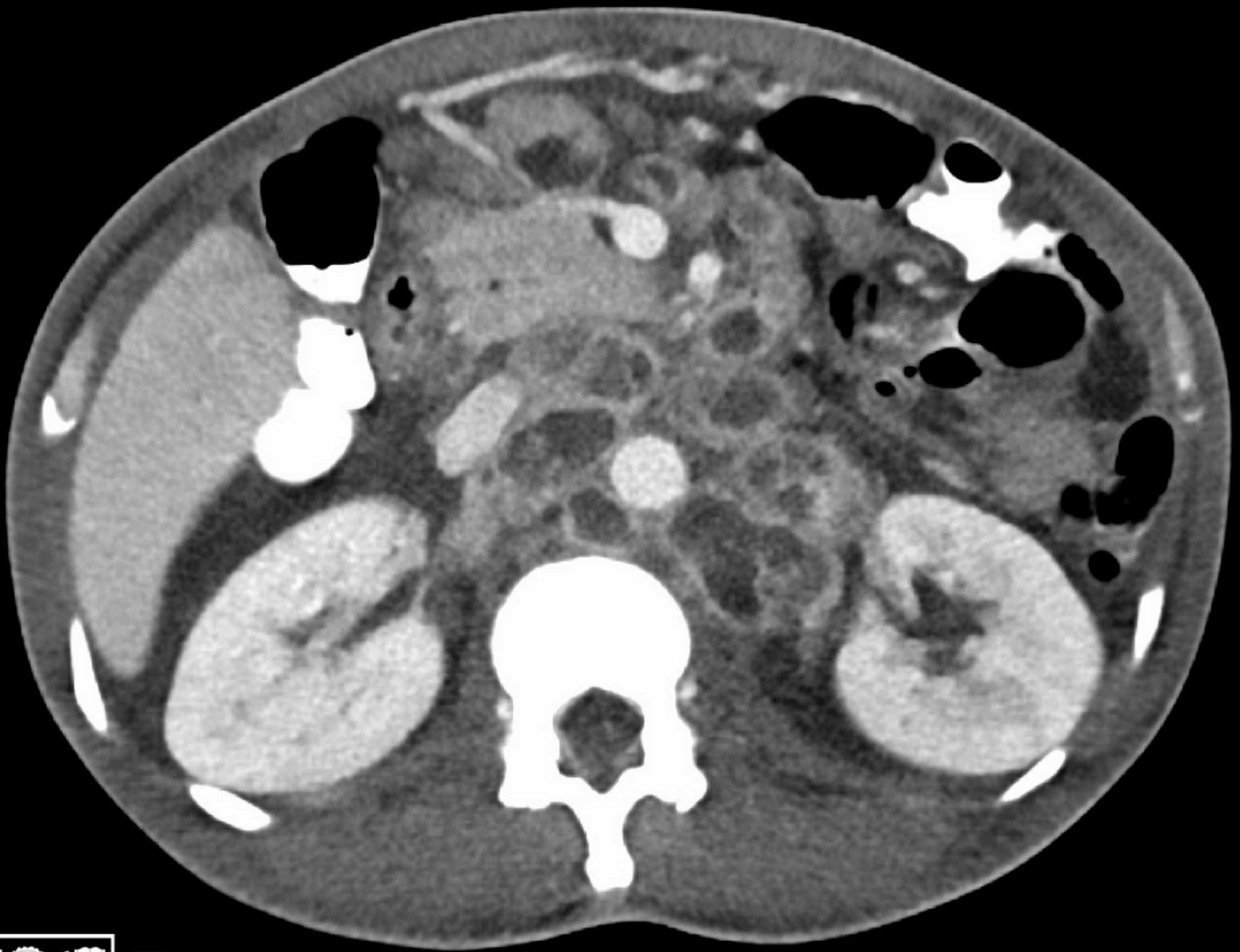
Additional images

Further imaging was obtained due to the patient's nonspecific abdominal discomfort.

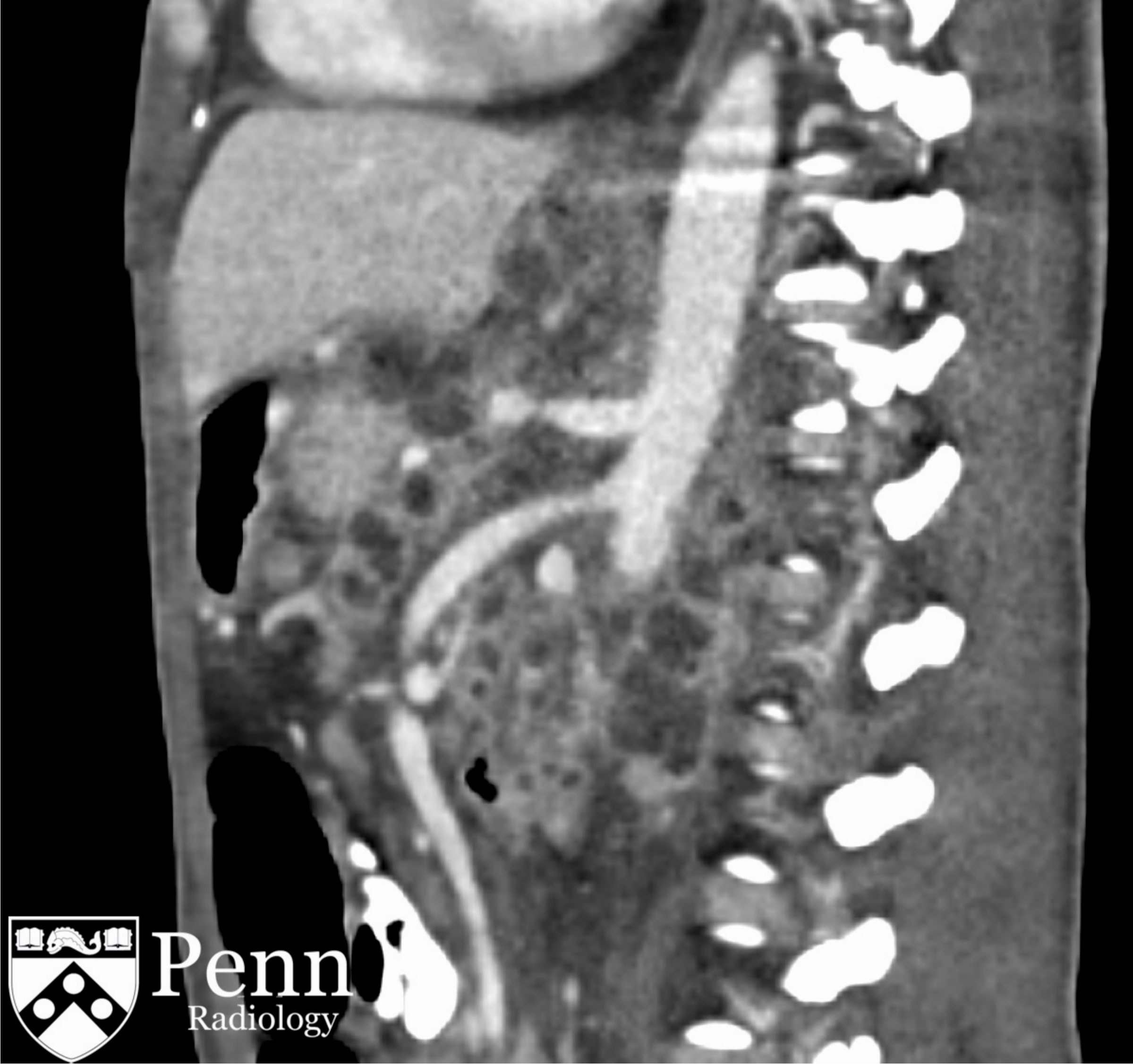
Contrast-enhanced CT scans of the chest and abdomen/pelvis were performed. Coronal, axial, and sagittal images are shown below. Click to enlarge.







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The findings are concerning for which of the following?

- ☐ Lymphoma
- ☐ Metastatic papillary thyroid carcinoma
- ☐ Metastatic squamous cell carcinoma
- ☐ *Mycobacterium tuberculosis* infection
- ☐ Nontuberculous mycobacterial infection
- ☐ Whipple disease
- ☐ Disseminated histoplasmosis infection
- ☐ Systemic lupus erythematosus

The question above accounts for 13% of your total score for this case.

The findings are concerning for which of the following?

- ☐ Lymphoma
- ☐ Metastatic papillary thyroid carcinoma
- ☐ Metastatic squamous cell carcinoma
- ☒ *Mycobacterium tuberculosis* infection (correct!)
- ☐ Nontuberculous mycobacterial infection
- ☐ Whipple disease
- ☐ Disseminated histoplasmosis infection
- ☐ Systemic lupus erythematosus

The question above accounts for 13% of your total score for this case.

Additional questions

After the patient's CT findings were discussed, he was transferred to isolation. A fine-needle biopsy of one of his cervical lymph nodes was then performed. The patient was also found to be HIV-positive with a CD4 count of 52.

Tuberculosis is often associated with lymphadenopathy.

☐ True

☐ False

The question above accounts for 13% of your total score for this case.

Lymphadenopathy as the sole radiographic finding of tuberculosis is common in adults.

☐ True

☐ False

The question above accounts for 12% of your total score for this case.

Additional questions

After the patient's CT findings were discussed, he was transferred to isolation. A fine-needle biopsy of one of his cervical lymph nodes was then performed. The patient was also found to be HIV-positive with a CD4 count of 52.

Tuberculosis is often associated with lymphadenopathy.

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Lymphadenopathy as the sole radiographic finding of tuberculosis is common in adults.

☐ True

☒ False (correct!)

The question above accounts for 12% of your total score for this case.

The question above accounts for 12% of your total score for this case.

Cervical lymphadenopathy findings in tuberculosis are often referred to as which of the following?

☐ Pott disease

☐ Scrofula

☐ Ranke complex

The question above accounts for 12% of your total score for this case.

Immunocompromised patients have a higher rate of extrapulmonary tuberculosis.

☐ True

☐ False

The question above accounts for 12% of your total score for this case.

Diagnosis of tuberculosis lymphadenitis can be made by imaging

The question above accounts for 12% of your total score for this case.

Cervical lymphadenopathy findings in tuberculosis are often referred to as which of the following?

- ☐ Pott disease
- ☒ Scrofula (correct!)
- ☐ Ranke complex

The question above accounts for 12% of your total score for this case.

Immunocompromised patients have a higher rate of extrapulmonary tuberculosis.

- ☒ True (correct!)
- ☐ False

The question above accounts for 12% of your total score for this case.

Diagnosis of tuberculosis lymphadenitis can be made by imaging

The question above accounts for 12% of your total score for this case.

Diagnosis of tuberculosis lymphadenitis can be made by imaging alone.

☐ True

☐ False

The question above accounts for 12% of your total score for this case.

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The question above accounts for 12% of your total score for this case.

Diagnosis of tuberculosis lymphadenitis can be made by imaging alone.

☐ True

☒ False (correct!)

[Explain this Answer]

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Diagnosis of tuberculosis lymphadenitis can be made by imaging alone.

☐ True

☒ False (correct!)

[Explain this Answer]

The question above accounts for 12% of your total score for this case.

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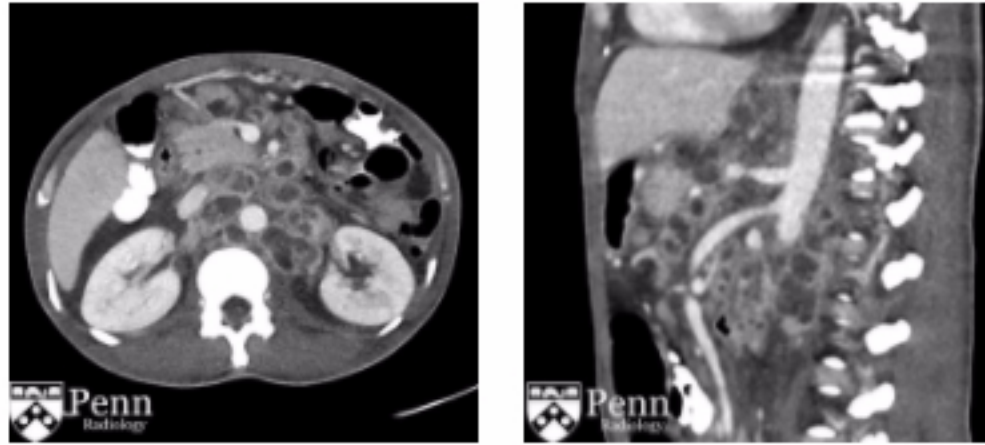
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Biopsy should be performed to confirm diagnosis and exclude other diagnoses, particularly malignancy.



Findings

Necrotic lymphadenopathy is seen through the cervical region, mediastinum, hila, abdomen, and retroperitoneum.

Differential diagnosis

- Tuberculous lymphadenopathy
- Lymphoma
- Metastatic carcinoma
- *Mycobacterium tuberculosis* infection
- Nontuberculous mycobacterial infection
- Disseminated histoplasmosis infection
- Whipple disease
- Autoimmune disease (i.e., systemic lupus erythematosus)

Diagnosis: Tuberculous lymphadenopathy, biopsy-proven

Tuberculous lymphadenopathy

Background

- Tuberculosis (TB) is typically confined to the respiratory system.
- However, it can affect any organ system, and immunocompromised patients have an increased risk of extrapulmonary TB.
- Radiographic evidence of lymphadenopathy is seen in more than 95% of children and over 40% of adults with TB.
- Lymphadenopathy as the only evidence of TB radiographically is more common in infants and decreases in frequency with age.

Imaging

CT:

- Lymph nodes larger than 2 cm often have a low attenuation center from necrosis and are suggestive of active disease.
- Cervical TB lymphadenopathy is often the first site of extrathoracic lymph node involvement; known as scrofula or cervical TB lymphadenitis.

Diagnosis

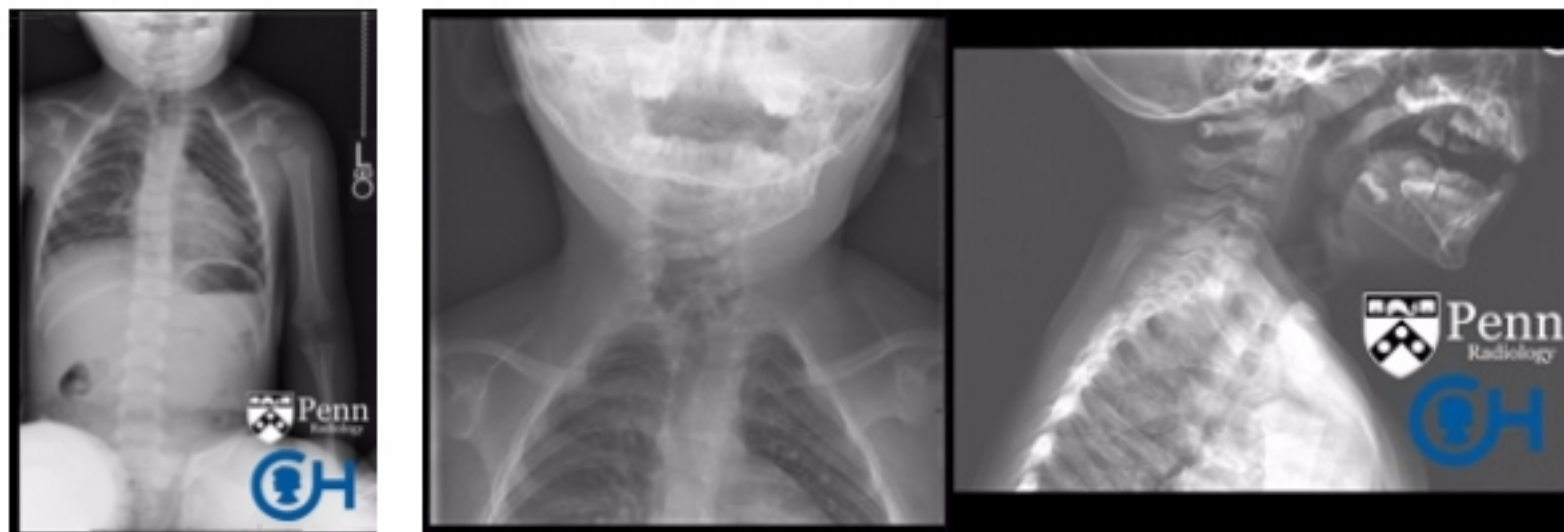
- Outside of the U.S., up to 50% of patients with chronic lymphadenopathy have TB as the causative etiology. However, malignancy is a significant alternative diagnosis.
- Thus, a biopsy is thus recommended to confirm TB and exclude other diagnoses.

History and images

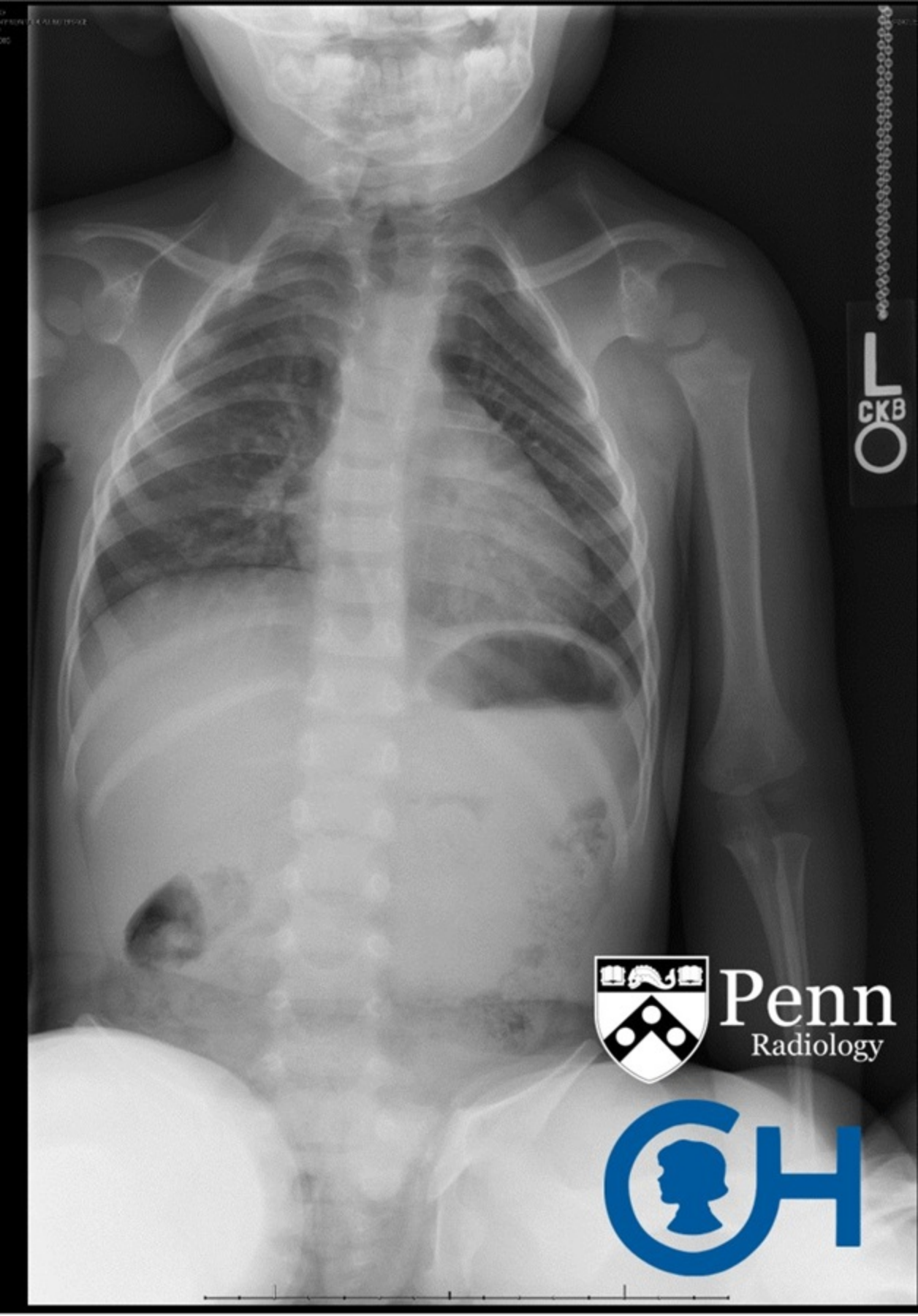
Our appreciation is extended to Dr. Jamaal Benjamin, PhD, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 25-month-old boy presented to his primary care provider with a concern for scoliosis. The physician ordered a scoliosis series and cervical spine radiographs.

Initial radiographs were concerning for possible bony abnormalities. Seated scoliosis radiograph and frontal and lateral view radiographs of the cervical spine are shown below. Click to enlarge.



A CT scan of the shoulders was ordered for additional characterization. Axial, sagittal, and 3D reconstructions of the shoulders are shown below.

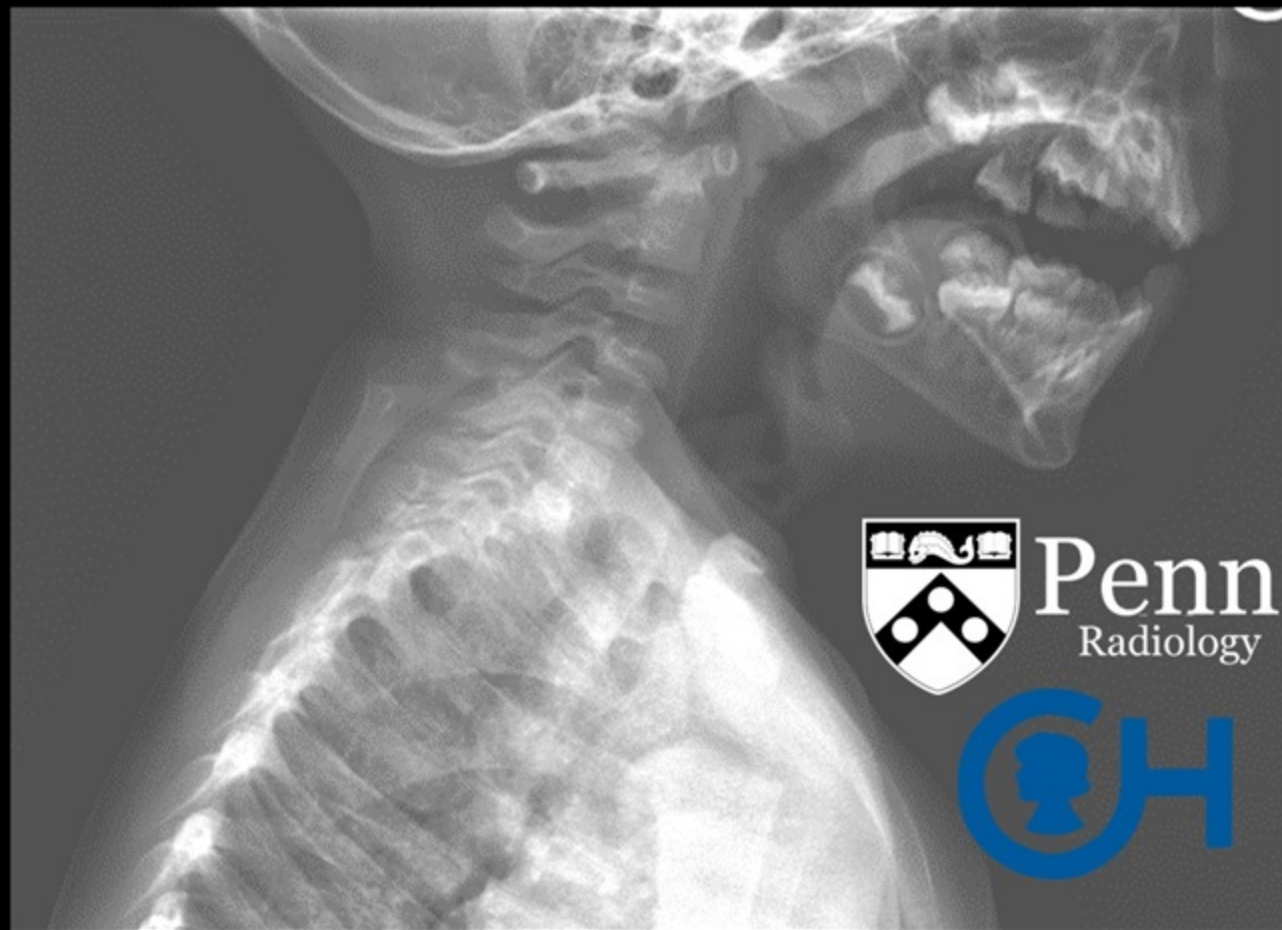
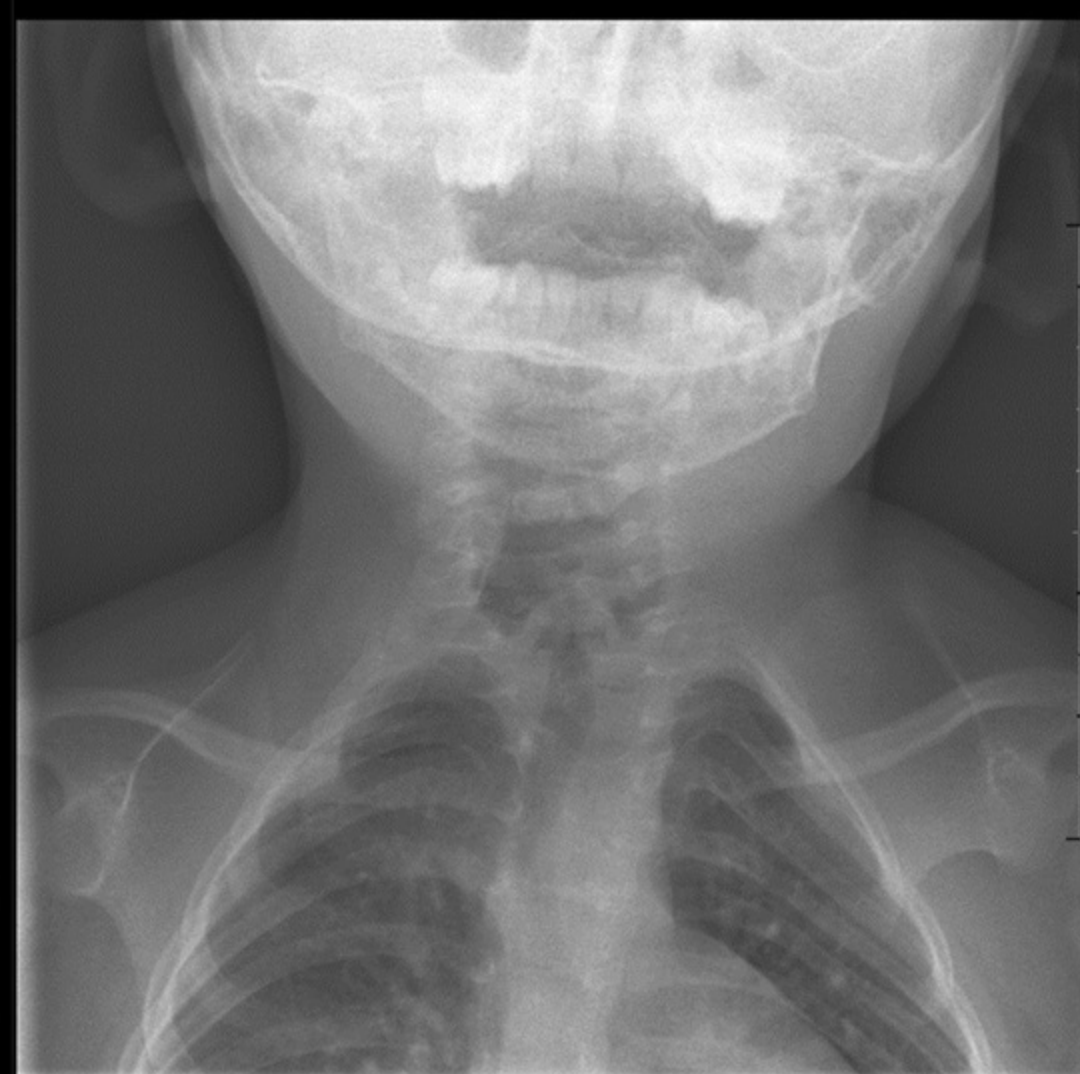


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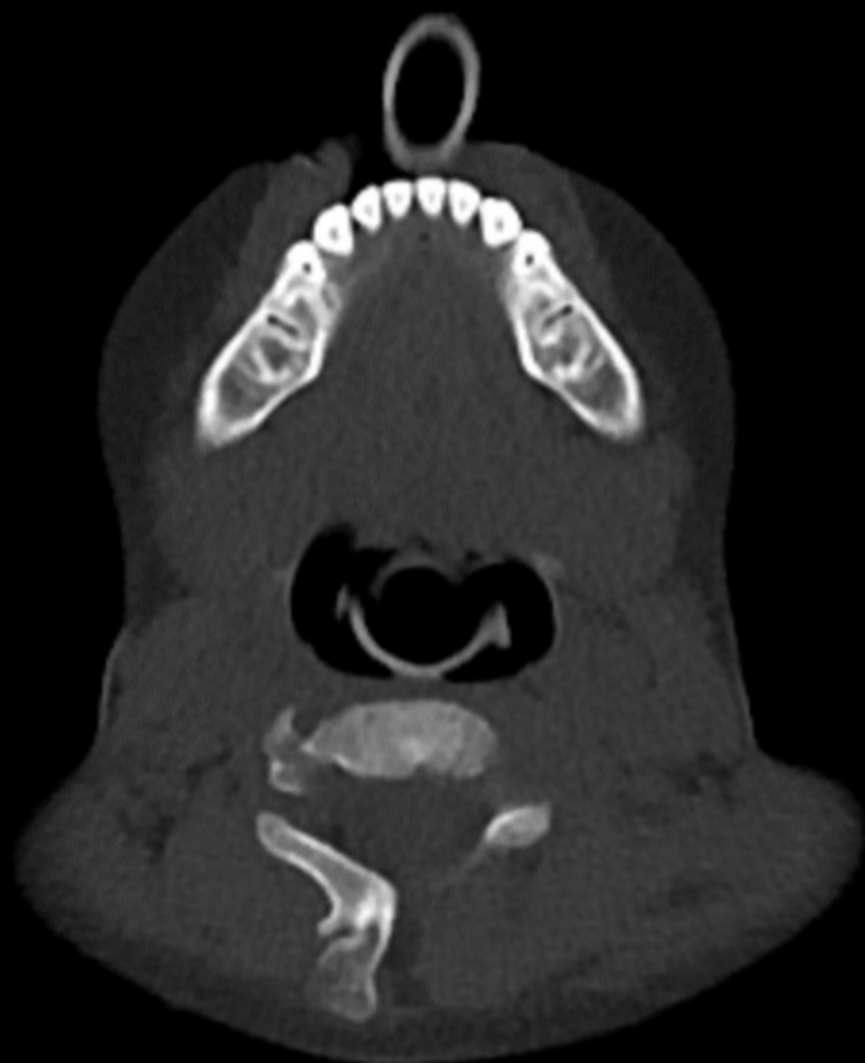
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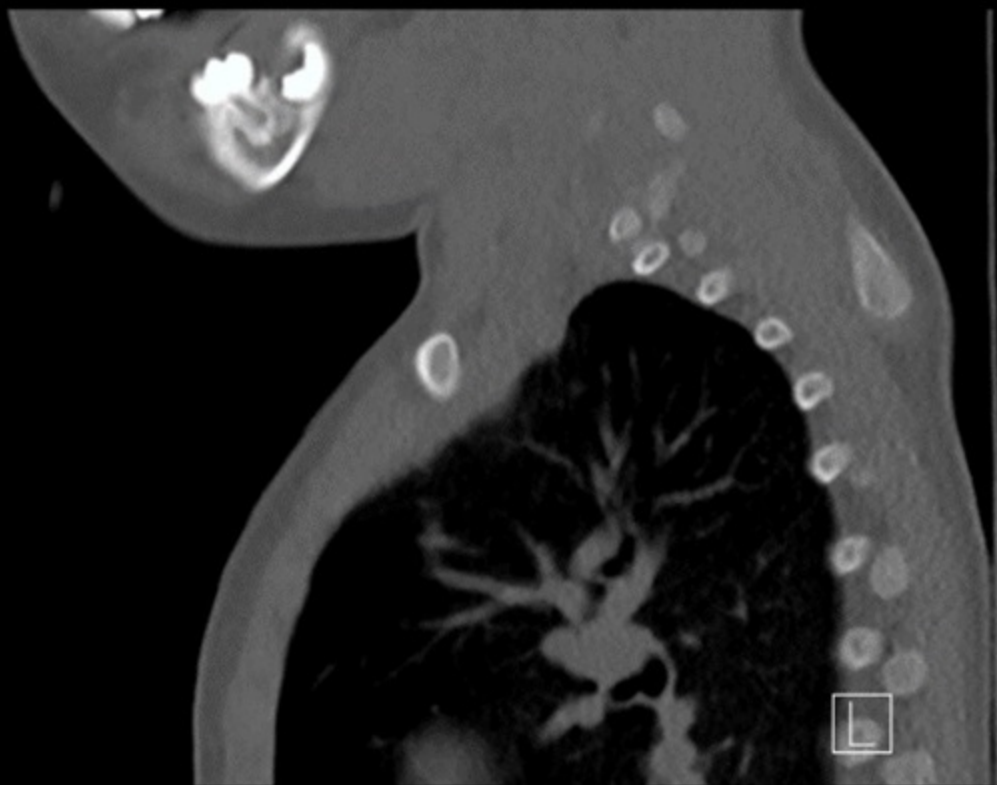






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R



L

Which of the following best explains the abnormal bony connection between the vertebral column and the superiomedial scapula?

- ☐ Omovertebral bone
- ☐ Abnormal epiphyseal ossification
- ☐ Metaphyseal dysostosis

The question above accounts for 18% of your total score for this case.

Based on the history and imaging findings, which of the following best explains the appearance of the left shoulder?

- ☒ Congenital nonunion of C1
- ☐ Sprengel deformity
- ☐ Dextroscoliosis of the thoracic spine
- ☐ None of the above

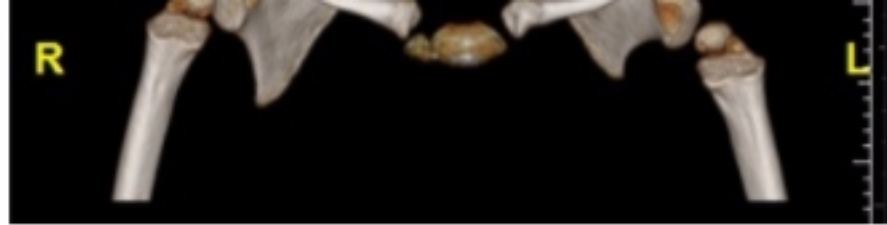
Which of the following best explains the abnormal bony connection between the vertebral column and the superomedial scapula?

- ☒ Omovertebral bone (correct!)
- ☐ Abnormal epiphyseal ossification
- ☐ Metaphyseal dysostosis

The question above accounts for 18% of your total score for this case.

Based on the history and imaging findings, which of the following best explains the appearance of the left shoulder?

- ☐ Congenital nonunion of C1
- ☒ Sprengel deformity (correct!)
- ☐ Dextroscoliosis of the thoracic spine
- ☐ None of the above



Findings

- **Radiographs:** There is a high-riding left scapula with a possibly slightly elevated right scapula. There appears to be an omovertebral bone.
- **Shoulder CT:** The bilateral scapulae are high-riding. There are bilateral omovertebral bones. The left omovertebral bone extends from the left scapular spine and articulates with the posterior elements of C4.

Differential diagnosis

- Sprengel deformity
- Scoliosis
- Osteomalacia
- Rickets
- Malunited scapular fractures

Diagnosis: Bilateral Sprengel deformity with bilateral omovertebral bones extending to C4

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Additional questions

All of the following abnormalities are associated with Sprengel deformity, **EXCEPT**:

☐ Klippel-Feil syndrome

☐ Scoliosis

☐ Hurler syndrome

☐ Rib anomalies

The question above accounts for 16% of your total score for this case.

Sprengel deformity is the most common congenital anomaly of the shoulder.

☐ True

☐ False

Additional questions

All of the following abnormalities are associated with Sprengel deformity, **EXCEPT**:

☐ Klippel-Feil syndrome

☐ Scoliosis

☒ Hurler syndrome (correct!)

☐ Rib anomalies

The question above accounts for 16% of your total score for this case.

Sprengel deformity is the most common congenital anomaly of the shoulder.

☒ True (correct!)

☐ False

The question above accounts for 15% of your total score for this case.

Sprengel deformity is most commonly which of the following?

☐ Bilateral

☐ Right-sided

☐ Left-sided

The question above accounts for 16% of your total score for this case.

Sprengel deformity is an entity that occurs equally in both sexes.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

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☐ Bilateral

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Sprengel deformity is an entity that occurs equally in both sexes.

☒ True (correct!)

☐ False

The question above accounts for 15% of your total score for this case.

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Key points

Sprengel deformity

Pathophysiology

- Sprengel deformity is a congenital elevation of one or both scapulae secondary to failure of its normal descent in the embryo.
- Most cases are sporadic with the exact etiology unknown.
- The cause of the deformity is thought to be secondary to abnormal intrauterine pressure.
- Failure of a scapula to descend leads to Sprengel deformity, in which the bone sits 2 cm to 10 cm higher than expected.

Epidemiology:

- It is the most common congenital anomaly of the scapula/shoulder girdle.
- The cause is unknown, and only a few cases of familial Sprengel deformity have been described.
- It is a rare condition, often found in association with more common disorders such as Klippel-Feil syndrome.

Clinical presentation

- Sprengel deformity often presents with cosmetic deformity and decreased shoulder function.
- It is commonly linked with other conditions, such as Klippel-Feil syndrome, scoliosis, and rib anomalies.

Imaging features

- Radiography:
 - Frontal radiograph demonstrates an asymmetric position of the scapulae with a high position of the scapular bases.
 - Lateral radiograph of cervical-upper thoracic spine shows a disturbance of the normal thoracic spine kyphosis.
- CT:
 - CT demonstrates abnormal elevation and rotation of the scapula.
 - Omovertebral bones are seen in a third of cases.
 - 3D reconstruction is useful for an accurate calculation of the extent of Sprengel deformity and the determination of associated osseous and/or muscular deformities.

Differential diagnoses

- Scoliosis
- Osteomalacia
- Rickets
- Malunited scapular fractures

Treatment and management

- Management for mild cases is nonsurgical.
- Surgical management is reserved for more severe cases.
 - Goals of surgery are improved cosmesis and function.
 - Woodward and Green procedures center around resection of the protruding portions scapula with inferior translation of the scapula.
- Best surgical outcomes are seen when management occurs when patients are

Treatment and management

- Management for mild cases is nonsurgical.
- Surgical management is reserved for more severe cases.
 - Goals of surgery are improved cosmesis and function.
 - Woodward and Green procedures center around resection of the protruding portions scapula with inferior translation of the scapula.
- Best surgical outcomes are seen when management occurs when patients are younger than 8 years old.

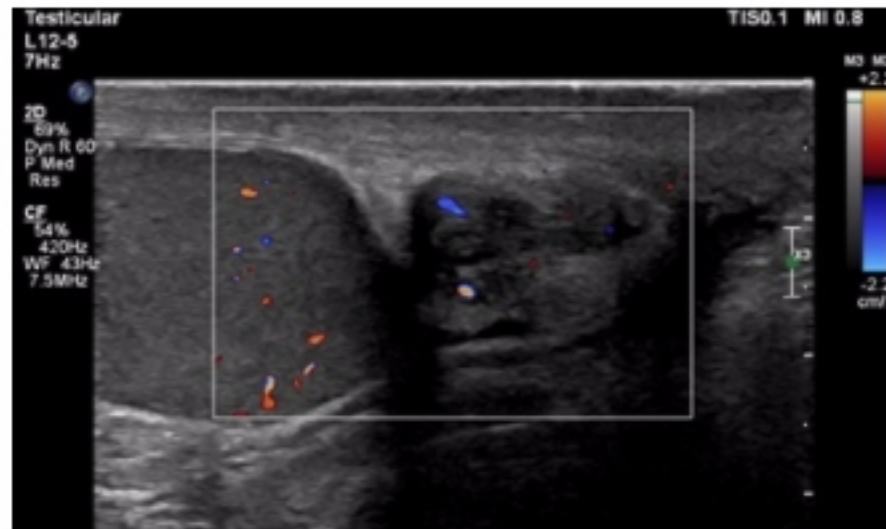
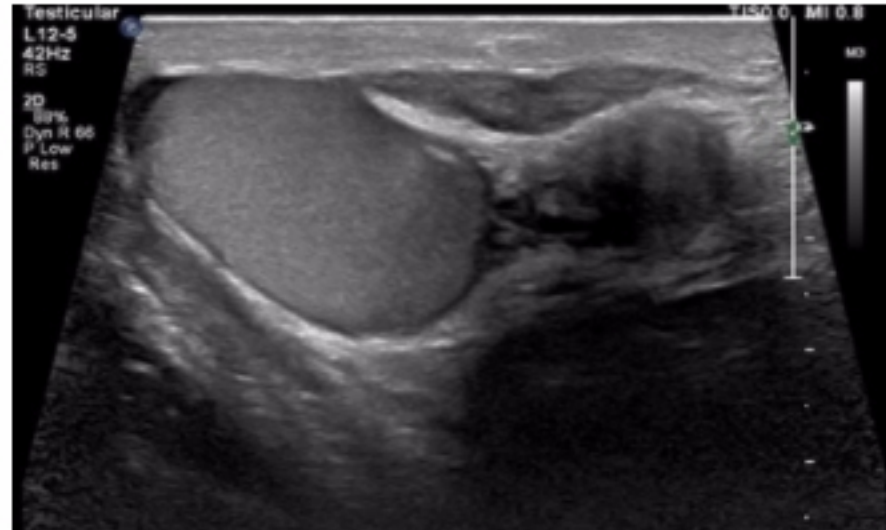
References

1. Bindoudi A, Kariki EP, Vasiliadis K, Tsitouridis I. The rare Sprengel deformity: Our experience with three cases. *J Clin Imaging Sci*. 2014;4:55.
2. Hadley HG. Sprengel's deformity. *Radiology*. 1941;36(5):624.
3. Harvey EJ, Bernstein M, Desy NM, Saran N, Ouellet JA. Sprengel deformity: Pathogenesis and management. *J Am Acad Orthop Surg*. 2012;20(3):177–186.
4. Kafadar C, Saglam M, Sonmez G, Mutlu H. Omovertebral bone associated with Sprengel deformity presented with chronic cervical pain. *Spine J*. 2016;16(2):e43.

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History: A 52-year-old man presents with left scrotal swelling that he's had for the past two months. The patient denies any history of trauma or infection, and he has no prior history of vasectomy or hernia repair.

A scrotal ultrasound scan was performed. Click images below to enlarge.



Testicular

L12-5

42Hz

RS

2D

88%

Dyn R 66

P Low

Res

TIS 0.0 MI 0.8

M3



Testicular

TIS0.1 MI 0.8

L12-5
7Hz

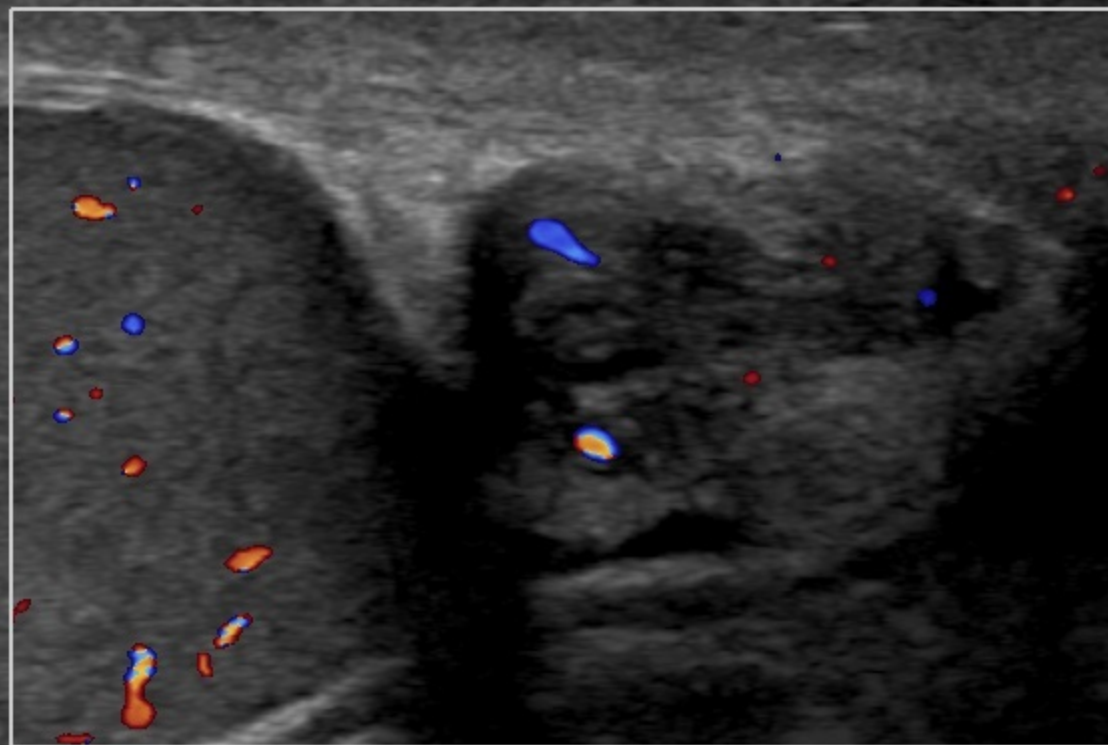
P

2D

69%
Dyn R 60
P Med
Res

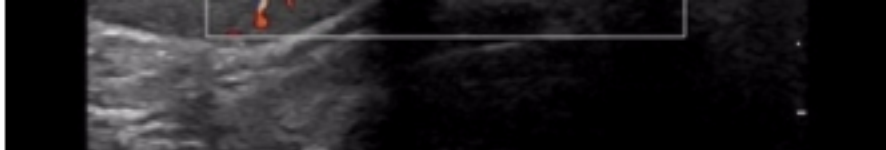
CF

54%
420Hz
WF 43Hz
7.5MHz



M3 M3
+2.2

-2.2
cm/s



Ultrasound shows a soft-tissue extratesticular mass.

☒ True

☐ False

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Ultrasound shows a soft-tissue extratesticular mass.

☒ True (correct!)

☐ False

The question above accounts for 17% of your total score for this case.

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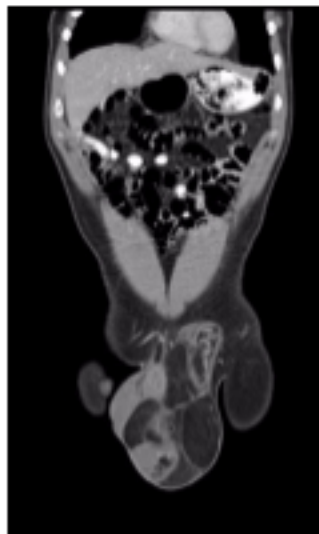
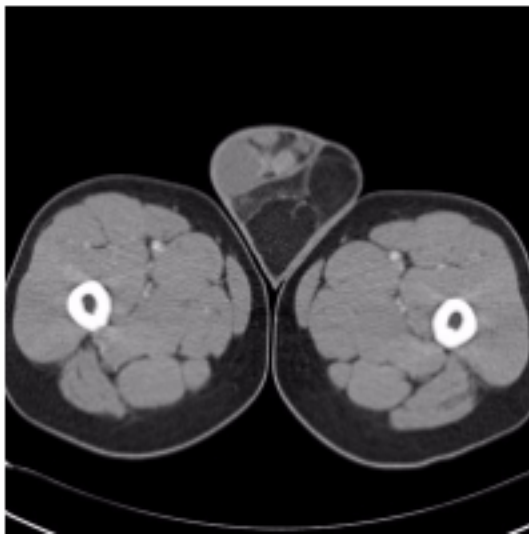
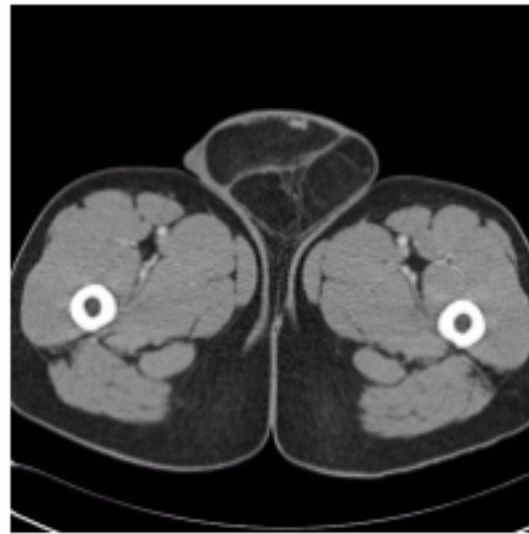
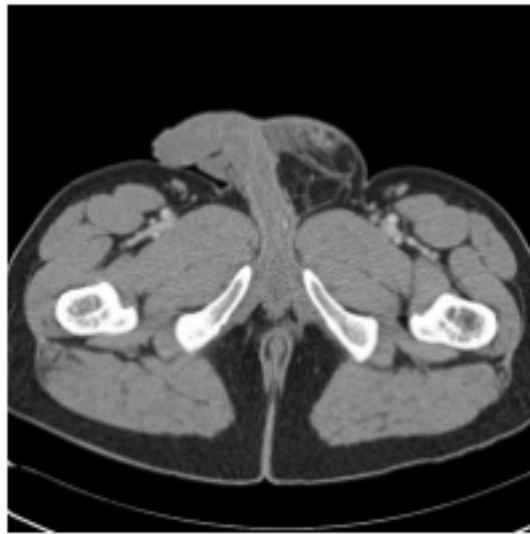
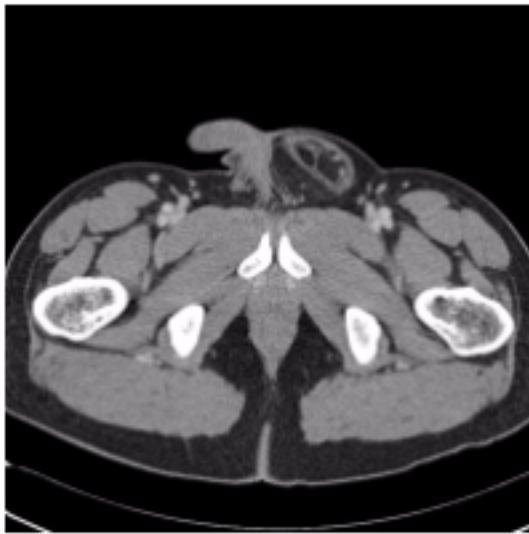
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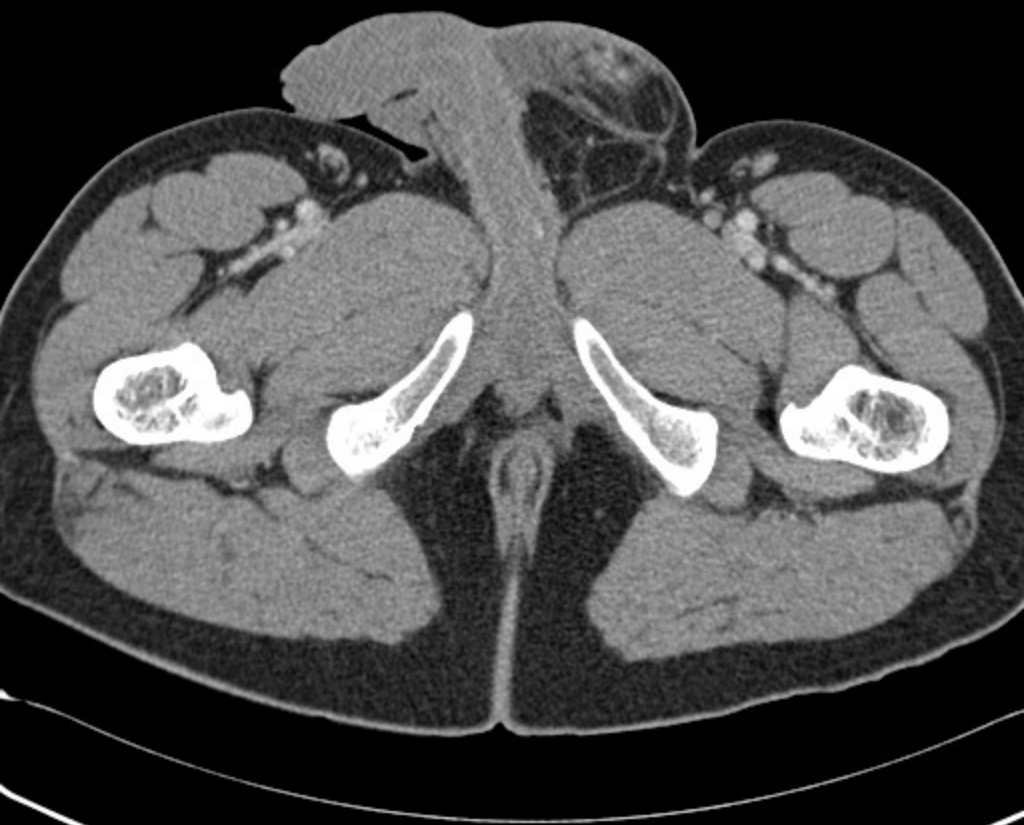
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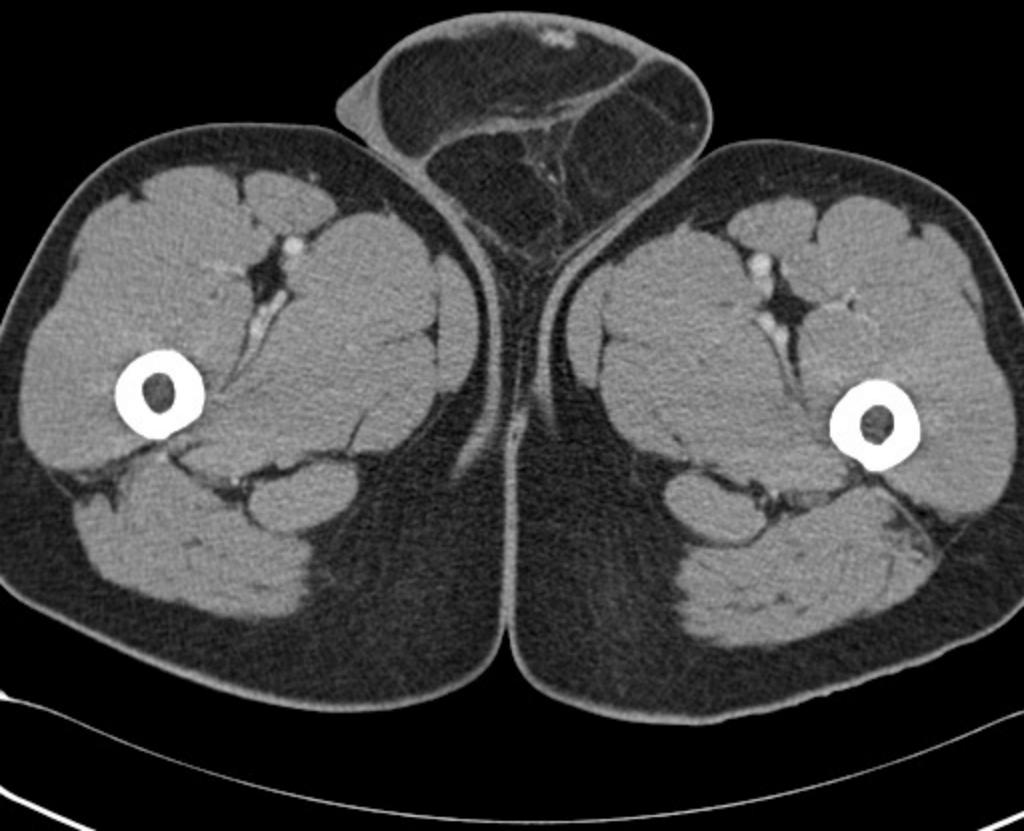
CT images

A contrast-enhanced CT scan was performed. Axial and coronal images are shown below. Click to enlarge.













What is the diagnosis?

- ☐ Adenomatoid tumor
- ☐ Inguinal hernia
- ☐ Lipoma
- ☐ Liposarcoma
- ☐ Lymphoma
- ☐ Malignant fibrous histiocytoma

The question above accounts for 17% of your total score for this case.

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What is the diagnosis?

- ☐ Adenomatoid tumor
- ☐ Inguinal hernia
- ☐ Lipoma
- ☒ Liposarcoma (correct!)
- ☐ Lymphoma
- ☐ Malignant fibrous histiocytoma

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Findings

- **Ultrasound:** Ultrasound demonstrates a soft-tissue extratesticular mass with mild internal vascularity displacing the testicle.
- **CT:** There is a large, heterogeneous, fat-containing mass in the region of the left spermatic cord with an associated soft-tissue density nodule.

Differential diagnosis

- Inguinal hernia
- Lipoma
- Adenomatoid tumor
- Malignant fibrous histiocytoma
- Liposarcoma
- Lymphoma

Diagnosis: Scrotal liposarcoma

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Additional questions

Liposarcoma is typically associated with high vascularity on ultrasound.

☐ True

☐ False

The question above accounts for 17% of your total score for this case.

Of the following, which is the most common lesion of the epididymis?

☐ Fibrous pseudotumor

☐ Metastasis

☐ Malignant fibrous histiocytoma

☒ Adenomatoid tumor

The question above accounts for 17% of your total score for this case.

Additional questions

Liposarcoma is typically associated with high vascularity on ultrasound.

☐ True

☒ False (correct!)

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

Of the following, which is the most common lesion of the epididymis?

☐ Fibrous pseudotumor

☐ Metastasis

☐ Malignant fibrous histiocytoma

☒ Adenomatoid tumor (correct!)

[\[Explain this Answer\]](#)

The question above accounts for 17% of your total score for this case.

Scrotal liposarcoma is more common in the pediatric population.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

Liposarcoma is more common in the retroperitoneum.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

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[\[Explain this Answer\]](#)

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Scrotal liposarcoma is more common in the pediatric population.

☐ True

☒ False (correct!)

[\[Explain this Answer\]](#)

The question above accounts for 16% of your total score for this case.

Liposarcoma is more common in the retroperitoneum.

☒ True (correct!)

☐ False

The question above accounts for 16% of your total score for this case.

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Key points

Scrotal liposarcoma

- Scrotal liposarcoma is a rare malignancy of the spermatic cord that presents in adults as large, painless, fat-containing lesions, often mistaken for hernias.
- The histologic types of liposarcoma include well-differentiated, myxoid, dedifferentiated, pleomorphic, and mixed.
- Features that help in differentiating liposarcomas from lipomas include a size greater than 10 cm, the presence of masses, and lesions less than 75% fat.
- As in this case, liposarcomas do not usually demonstrate high vascularity on ultrasound.
- Tumors typically spread by direct invasion.
- Treatment is wide local excision. Chemotherapy and radiation have been used as adjunct therapies; however, given the infrequency of the diagnosis, the standard of care is not currently well-established.
- Positive surgical margins often result in tumor recurrence.
- The most common extratesticular masses are lipomas, adenomatoid tumors, and fibrous pseudotumors.
- Metastasis to the epididymis is rare, most commonly from the prostate.

References

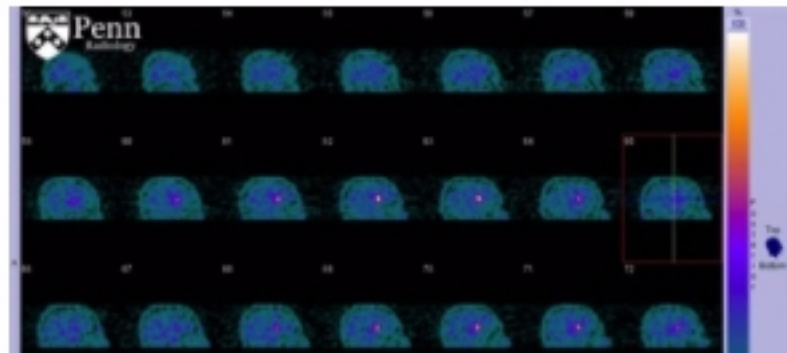
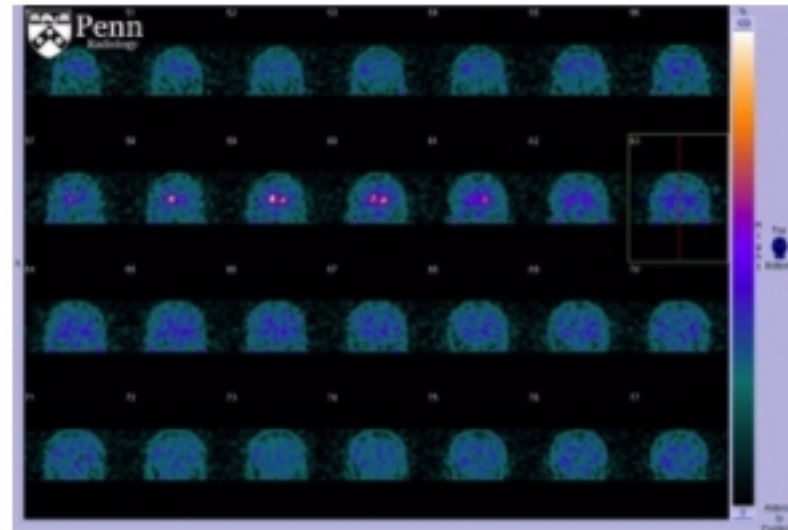
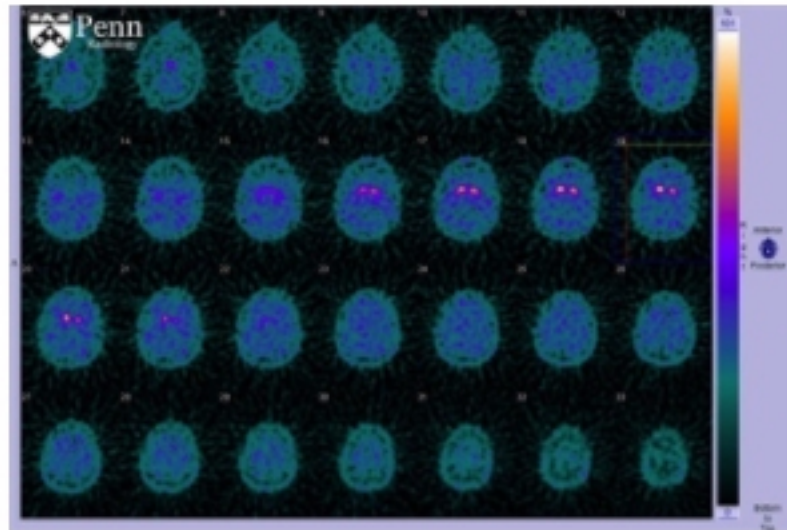
1. Cassidy FH, Ishioka KM, McMahon CJ, et al. MR imaging of scrotal tumors and pseudotumors. *Radiographics*. 2010;30(3):665-683.

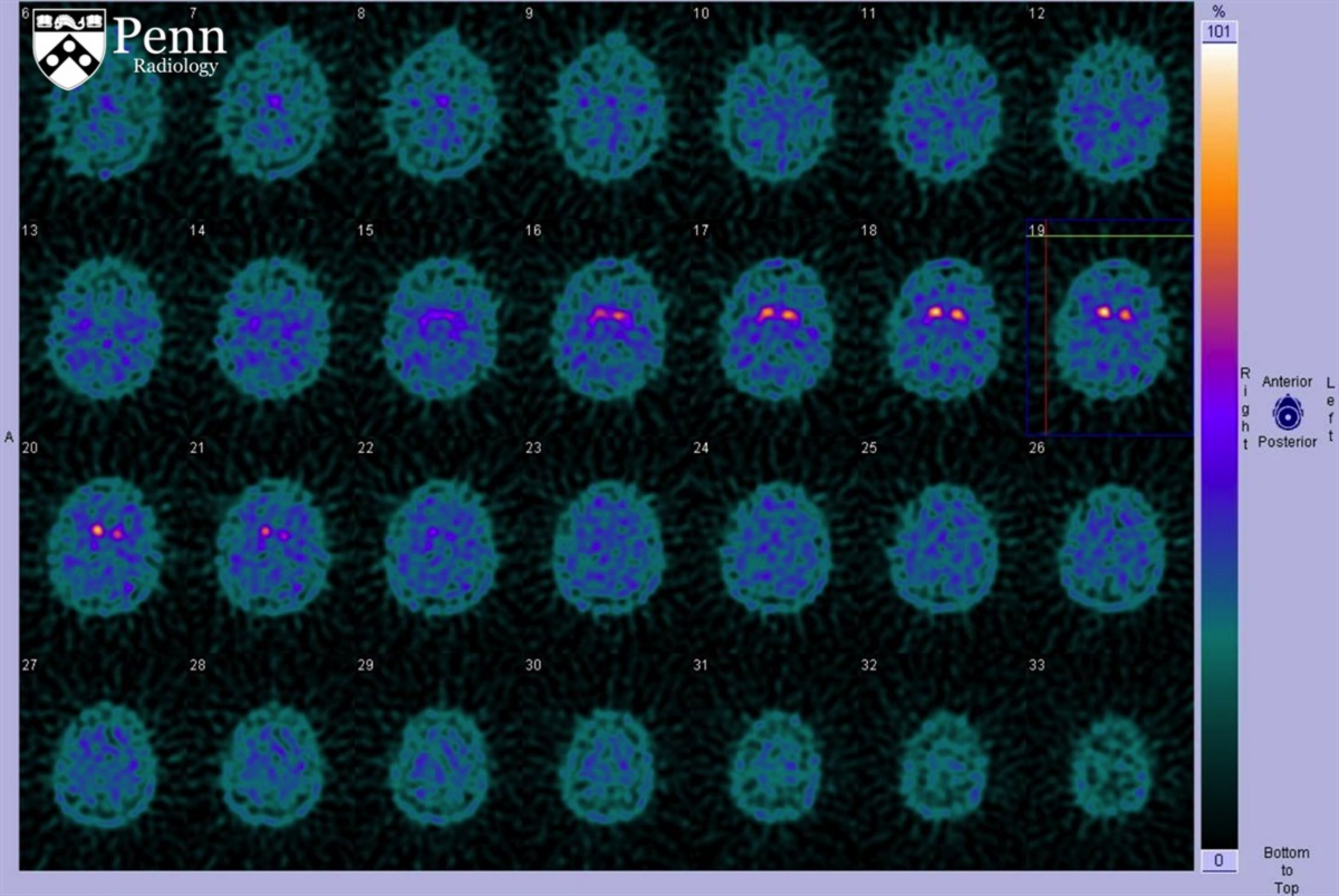
History and SPECT images

Our appreciation is extended to Dr. Akash Patel, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 66-year-old man with worsening resting tremor, bradykinesia, and rigidity presents to the neurologist for an evaluation.

An iodine-123 (I-123) ioflupane SPECT scan was performed. Axial, coronal, and sagittal images are shown below. Click to enlarge.





51

52

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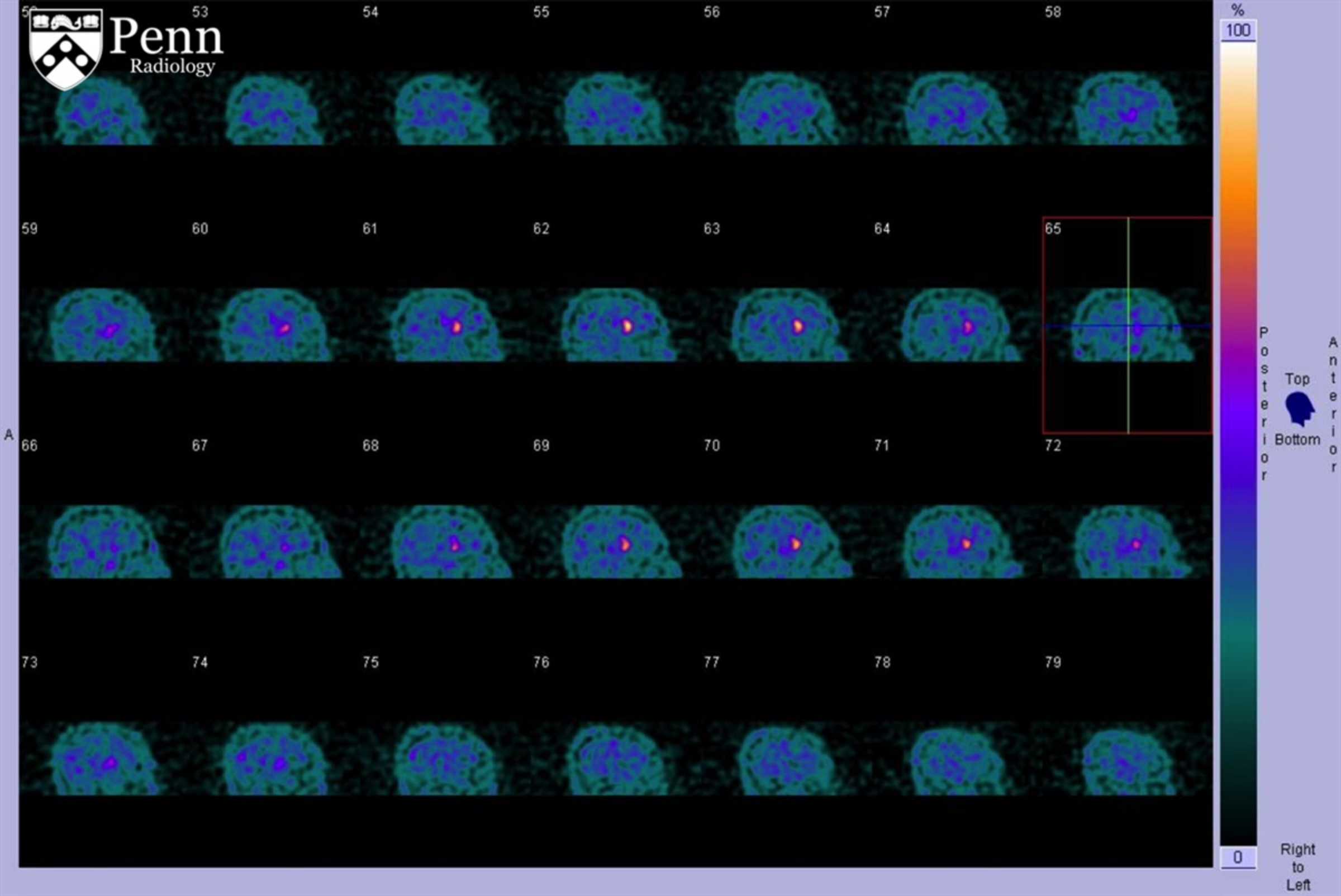
77

Right
Top
Left
Bottom



0

Anterior
to
Posterior





There is symmetrically decreased putaminal uptake bilaterally.

☒ True

☐ False

The question above accounts for 17% of your total score for this case.

What is the predominant energy of the gamma rays emitted by the radiotracer used above?

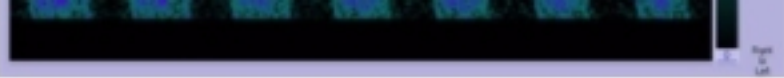
☐ 140 keV

☐ 159 keV

☐ 364 keV

☐ 411 keV

The question above accounts for 16% of your total score for this case.



There is symmetrically decreased putaminal uptake bilaterally.

☐ True

☒ False (correct!)

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

What is the predominant energy of the gamma rays emitted by the radiotracer used above?

☐ 140 keV

☒ 159 keV (correct!)

☐ 364 keV

☐ 411 keV

[Explain this Answer]

There is symmetrically decreased putaminal uptake bilaterally

☐ True

☒ False (correct!)

[Explain this Answer]

The question above accounts for 17% of your total score

What is the predominant energy of radiotracer use above?

☐ 140 keV

☒ 159 keV (correct!)

☐ 364 keV

☐ 411 keV

[Explain this Answer]

The bilateral decreased putaminal uptake is slightly asymmetrical.

Which of the following anatomic structures normally accumulates the above radiotracer?

- ☐ Striatum
- ☐ Pineal gland
- ☐ Thalami
- ☐ Internal capsule

The question above accounts for 16% of your total score for this case.

Which of the following transporters does the radiotracer have the highest affinity for?

- ☐ Norepinephrine transporter
- ☐ Somatostatin transporter
- ☐ Dopamine transporter
- ☐ Benzodiazepine transporter

Which of the following anatomic structures normally accumulates the above radiotracer?

☒ Striatum (correct!)

☐ Pineal gland

☐ Thalami

☐ Internal capsule

The question above accounts for 16% of your total score for this case.

Which of the following transporters does the radiotracer have the highest affinity for?

☐ Norepinephrine transporter

☐ Somatostatin transporter

☒ Dopamine transporter (correct!)

☐ Benzodiazepine transporter

☒ Dopamine transporter (correct!)

☐ Benzodiazepine transporter

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

For which of the following clinical differential diagnoses is I-123 ioflupane SPECT the most useful in differentiating?

☐ Parkinson's disease versus essential tremor

☐ Parkinson's disease versus corticobasal degeneration

☐ Corticobasal degeneration versus dementia with Lewy bodies

☒ Dementia with Lewy bodies versus multiple system atrophy

The question above accounts for 17% of your total score for this case.

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☒ Dopamine transporter (correct!)

☐ Benzodiazepine transporter

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

For which of the following clinical differential diagnoses is I-123 ioflupane SPECT the most useful in differentiating?

☒ Parkinson's disease versus essential tremor (correct!)

☐ Parkinson's disease versus corticobasal degeneration

☐ Corticobasal degeneration versus dementia with Lewy bodies

☐ Dementia with Lewy bodies versus multiple system atrophy

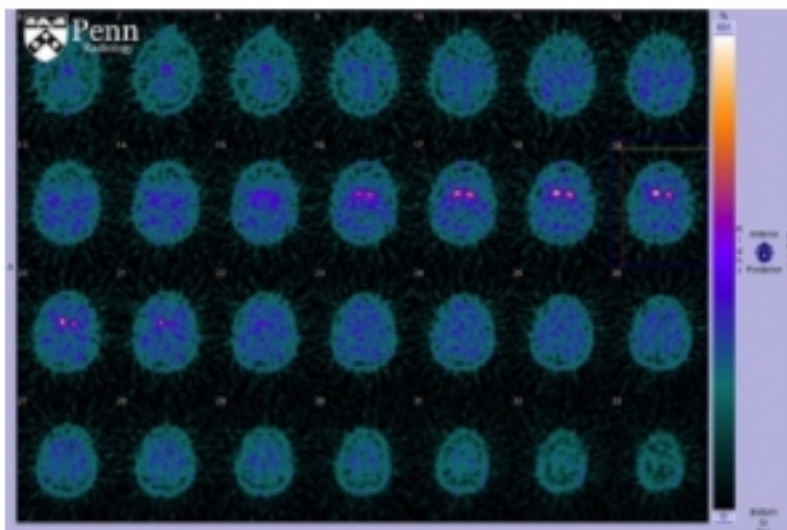
[Explain this Answer]

The question above accounts for 17% of your total score for this case.

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Additional questions

Axial I-123 ioflupane SPECT images are shown again below.



This case is compatible with a clinical diagnosis of Parkinson's disease.

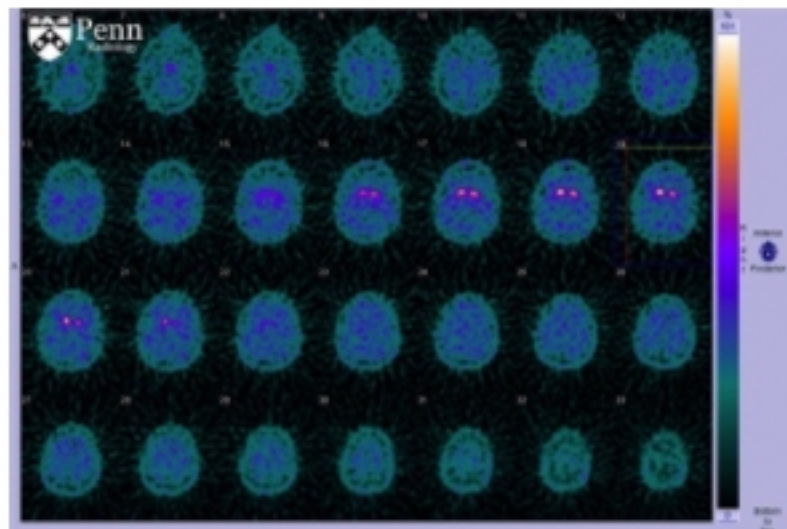
☐ True

☐ False

The question above accounts for 17% of your total score for this case.

Additional questions

Axial I-123 ioflupane SPECT images are shown again below.



This case is compatible with a clinical diagnosis of **Parkinson's disease**.

☒ True (correct!)

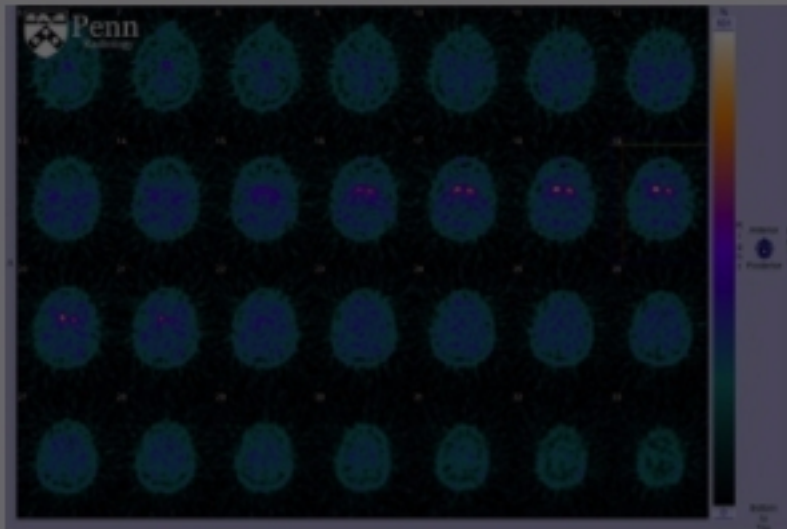
☐ False

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

Additional questions

Axial I-123 ioflupane SPECT images are shown.



This case is compatible with a clinical diagnosis of Parkinson's disease.

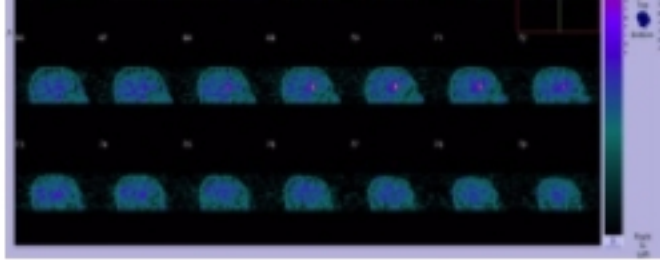
☒ True (correct!)

☐ False

[Explain this Answer]

The question above accounts for 17% of your total score for this case.

There is blunting of the normal comma-shaped appearance of the striata bilaterally with asymmetrically decreased putaminal uptake bilaterally. This is compatible with Parkinson's disease in the appropriate clinical scenario.



Findings

I-123 ioflupane SPECT demonstrates blunting of the normal comma-shaped striata bilaterally and decreased putaminal radiotracer uptake bilaterally (slightly asymmetrical).

Differential diagnosis

- Parkinson's disease
- Multiple system atrophy
- Progressive supranuclear palsy
- Dementia with Lewy bodies
- Corticobasal degeneration

Diagnosis: Parkinson's disease

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Key points

Parkinson's disease

Pathophysiology

- Approximately 70% to 80% of pathology results from loss of dopaminergic neurons that project from the substantia nigra pars compacta in the midbrain to the striatum (putamen and caudate nucleus).
- Lateral projections to the posterior putamen are commonly affected earlier and to a greater extent than the medial projections to the caudate nucleus.
- Hallmark pathologic feature includes Lewy bodies (alpha-synuclein in misfolded state aggregates to form intracellular inclusions).

Epidemiology

- Parkinson's disease is the most common neurodegenerative disorder after Alzheimer's disease.
- Idiopathic Parkinson's disease has a 1% prevalence among Europeans (ages 65 to 85).
- The male-to-female ratio is 3:2.

Clinical presentation

- Classic symptoms include bradykinesia, muscular rigidity, resting tremor, and postural and gait impairments.
- Two major subtypes:

Clinical presentation

- Classic symptoms include bradykinesia, muscular rigidity, resting tremor, and postural and gait impairments.
- Two major subtypes:
 - Tremor-dominant Parkinson's disease with relative absence of other motor symptoms
 - Nontremor-dominant Parkinson's disease

Imaging features

- I-123 ioflupane SPECT:
 - Decreased striatal activity (usually asymmetric)
 - Sensitivity and specificity exceeding 90%
- MRI:
 - Often normal
 - Occasional diffuse atrophy
 - T2 hyperintense foci can be seen in the globus pallidus
 - Putaminal volume loss
 - Narrowed/inapparent substantia nigra pars compacta on T2-weighted images
 - Loss of normal substantia nigra pars compacta hyperintensity from lateral to medial
 - Increased apparent diffusion coefficient in putamen and caudate nucleus
- FDG-PET/CT:
 - Often normal with preserved putaminal activity
 - Occasional decreased uptake in the parieto-occipital cortex

Differential diagnoses

Differential diagnoses include atypical Parkinsonian syndromes:

- Multiple system atrophy
- Progressive supranuclear palsy
- Dementia with Lewy bodies
- Corticobasal degeneration

Treatment

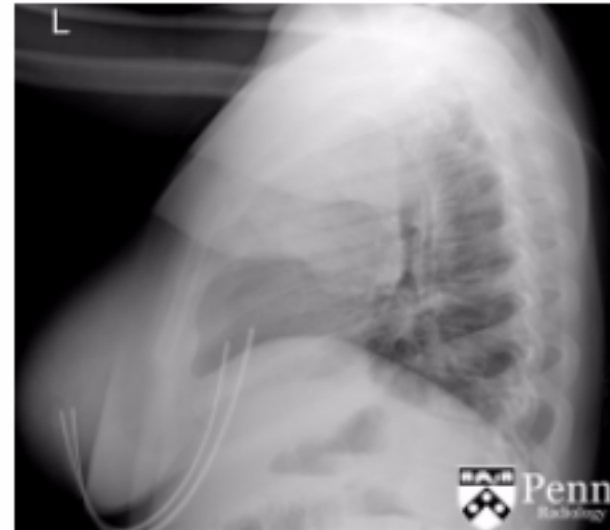
- Drugs that increase intracerebral dopamine concentration or stimulate dopamine receptors remain the mainstay of treatment for motor symptoms. These include levodopa, dopamine agonists, monoamine oxidase type B inhibitors, and amantadine.
- Anticholinergics can be effective for tremors.
- Antidepressants are prescribed for associated depression.
- Deep brain stimulation may be used for motor symptoms.
- Stereotactic pallidotomy also is an option for medically refractory cases.

References

1. Booth TC, Nathan M, Waldman AD, Quigley AM, Schapira AH, Buscombe J. The role of functional dopamine-transporter SPECT imaging in parkinsonian syndromes, part 2. *AJNR Am J Neuroradiol*. 2015;36(2):236-244.
2. Broski SM, Hunt CH, Johnson GB, Morreale RF, Lowe VJ, Peller PJ. Structural and functional imaging in parkinsonian syndromes. *Radiographics*. 2014;34(5):1273-1292.

History: A 19-year-old woman presents to the emergency department with chest pain.

Posteroanterior (PA) and lateral chest radiographs were obtained. Click images below to enlarge.



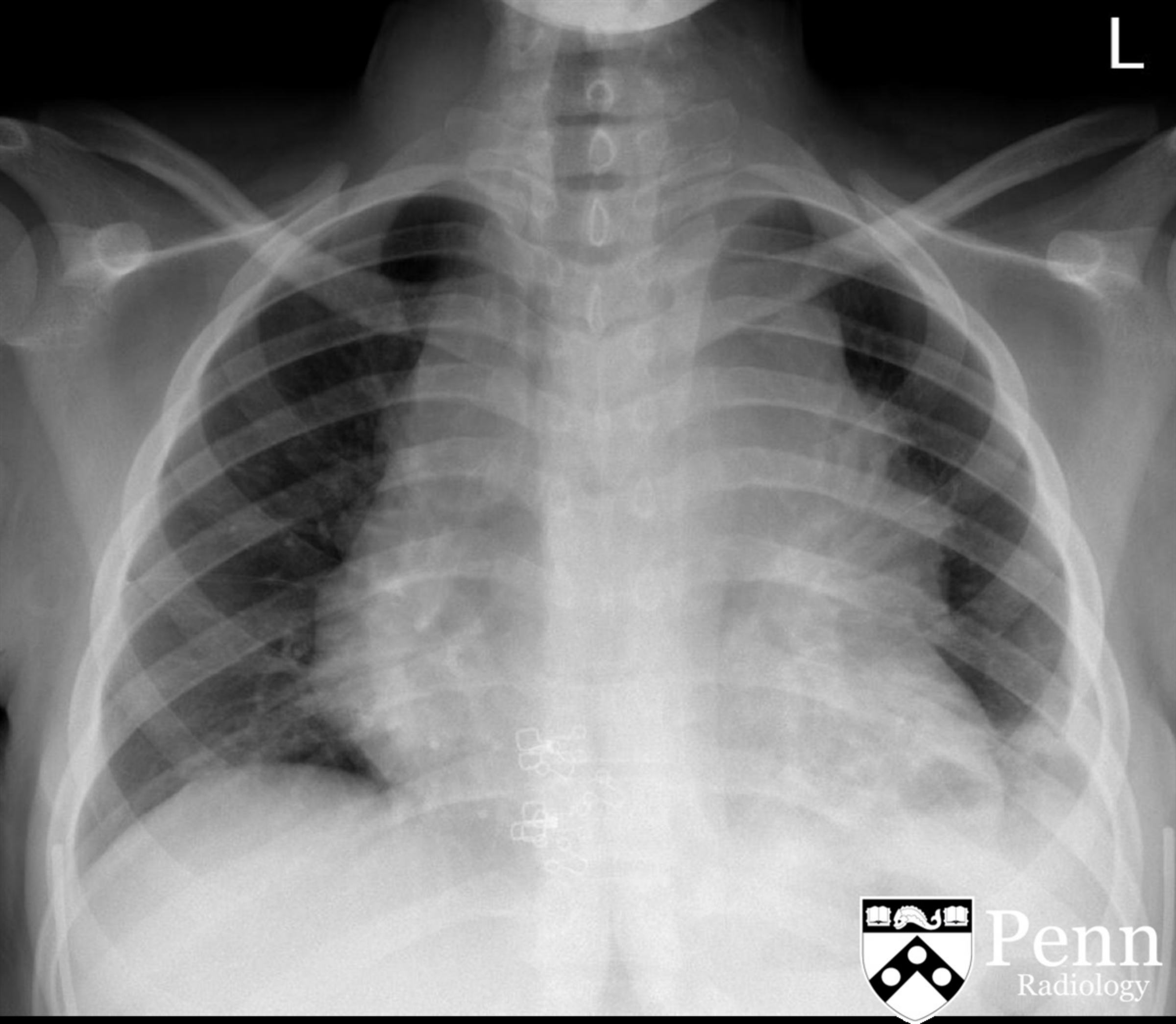
Where is the abnormality located?

☐ Anterior mediastinum

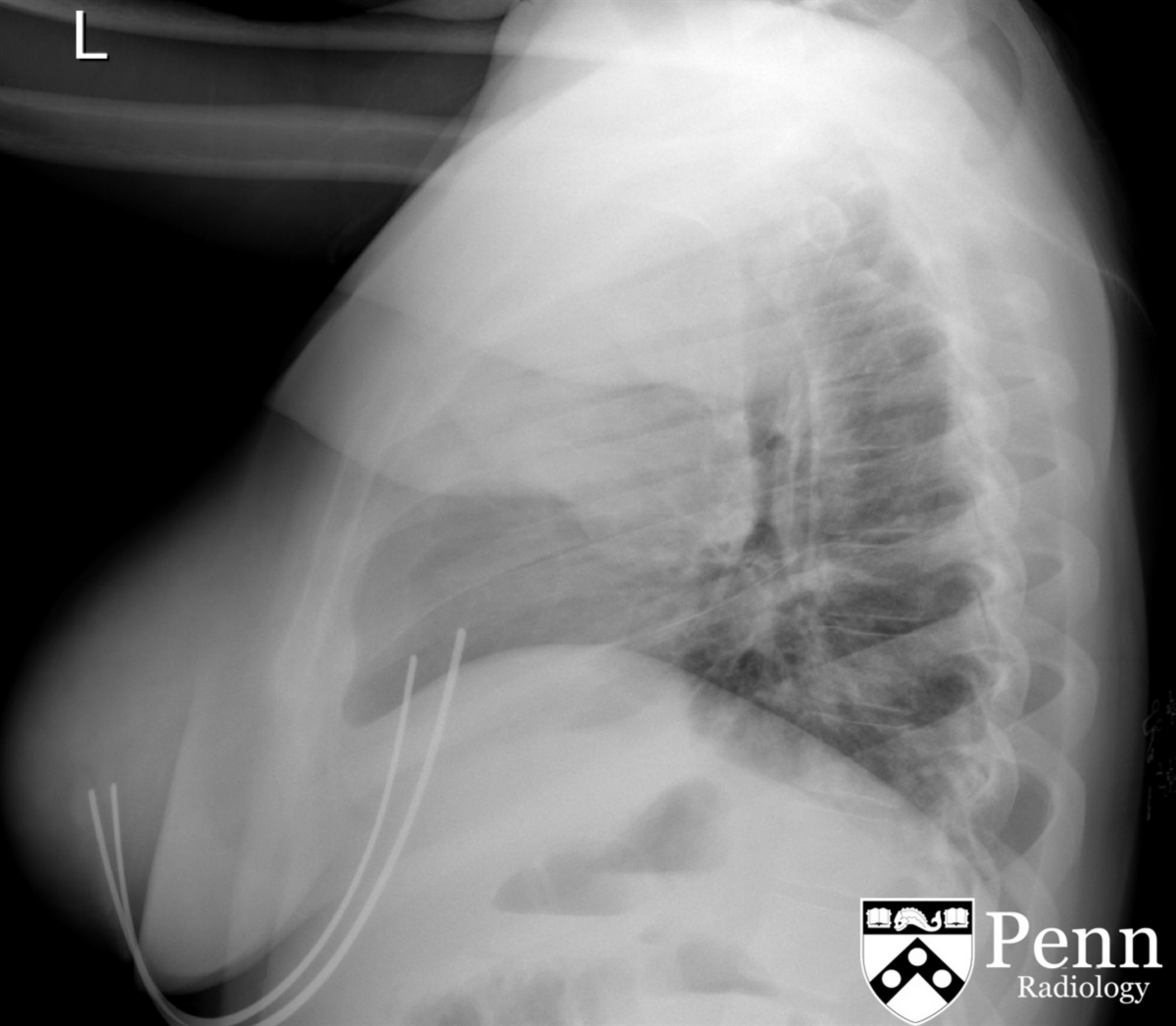
☐ Posterior mediastinum

☐ Aorta

☐ Heart



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Where is the abnormality located?

☐ Anterior mediastinum

☐ Posterior mediastinum

☐ Aorta

☐ Heart

The question above accounts for 33% of your total score for this case.

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Where is the abnormality located?

☒ Anterior mediastinum (correct!)

☐ Posterior mediastinum

☐ Aorta

☐ Heart

The question above accounts for 33% of your total score for this case.

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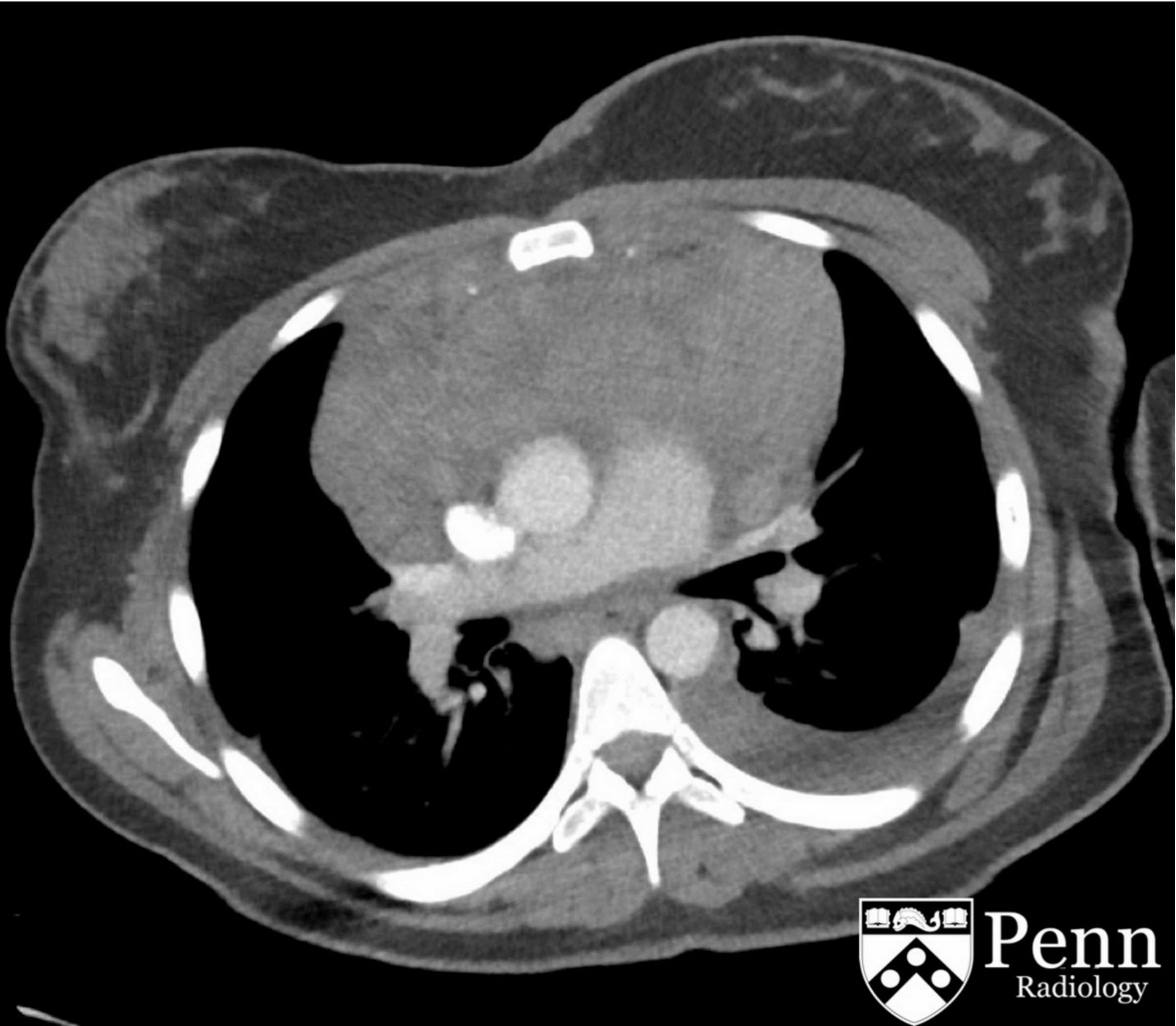
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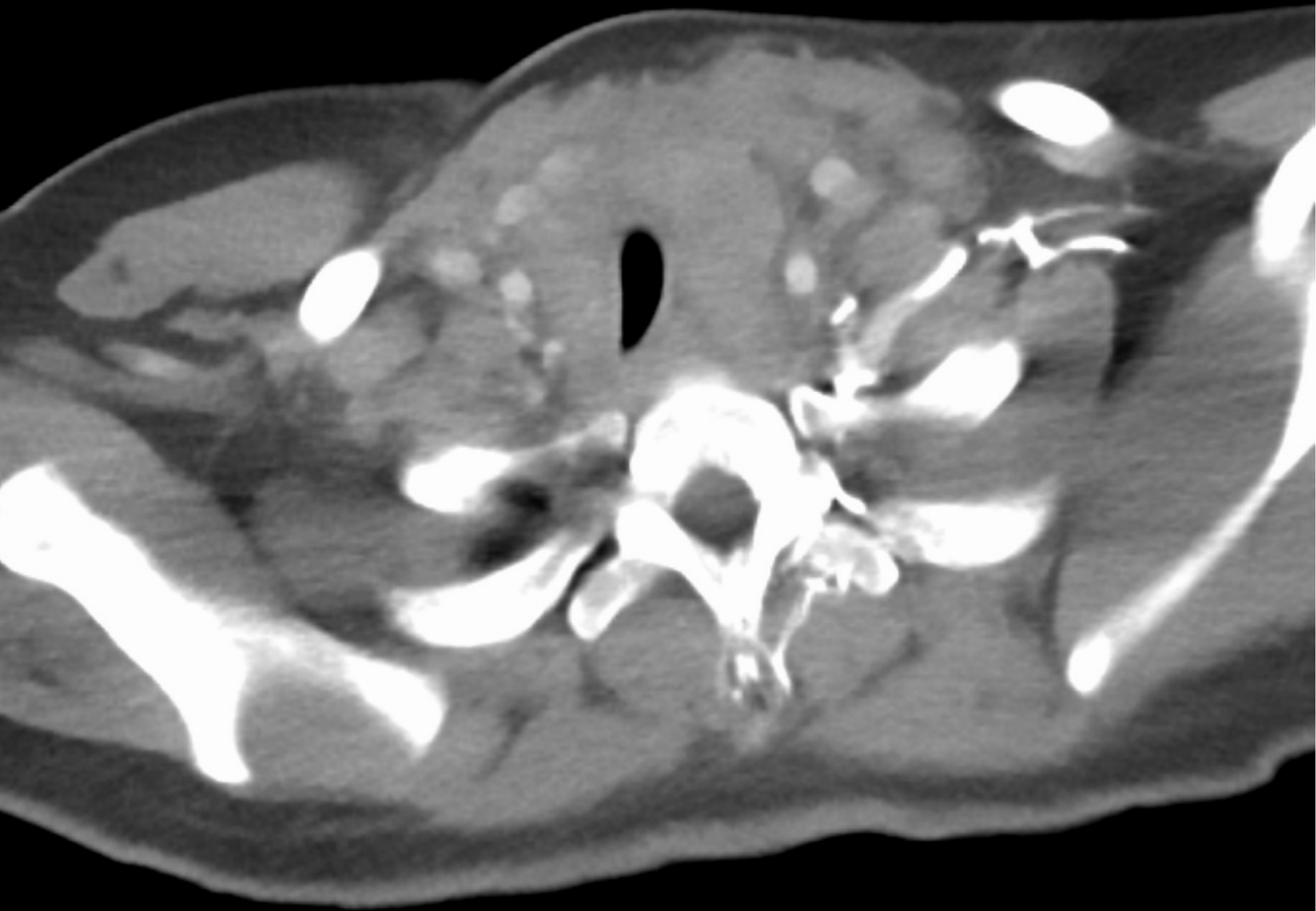
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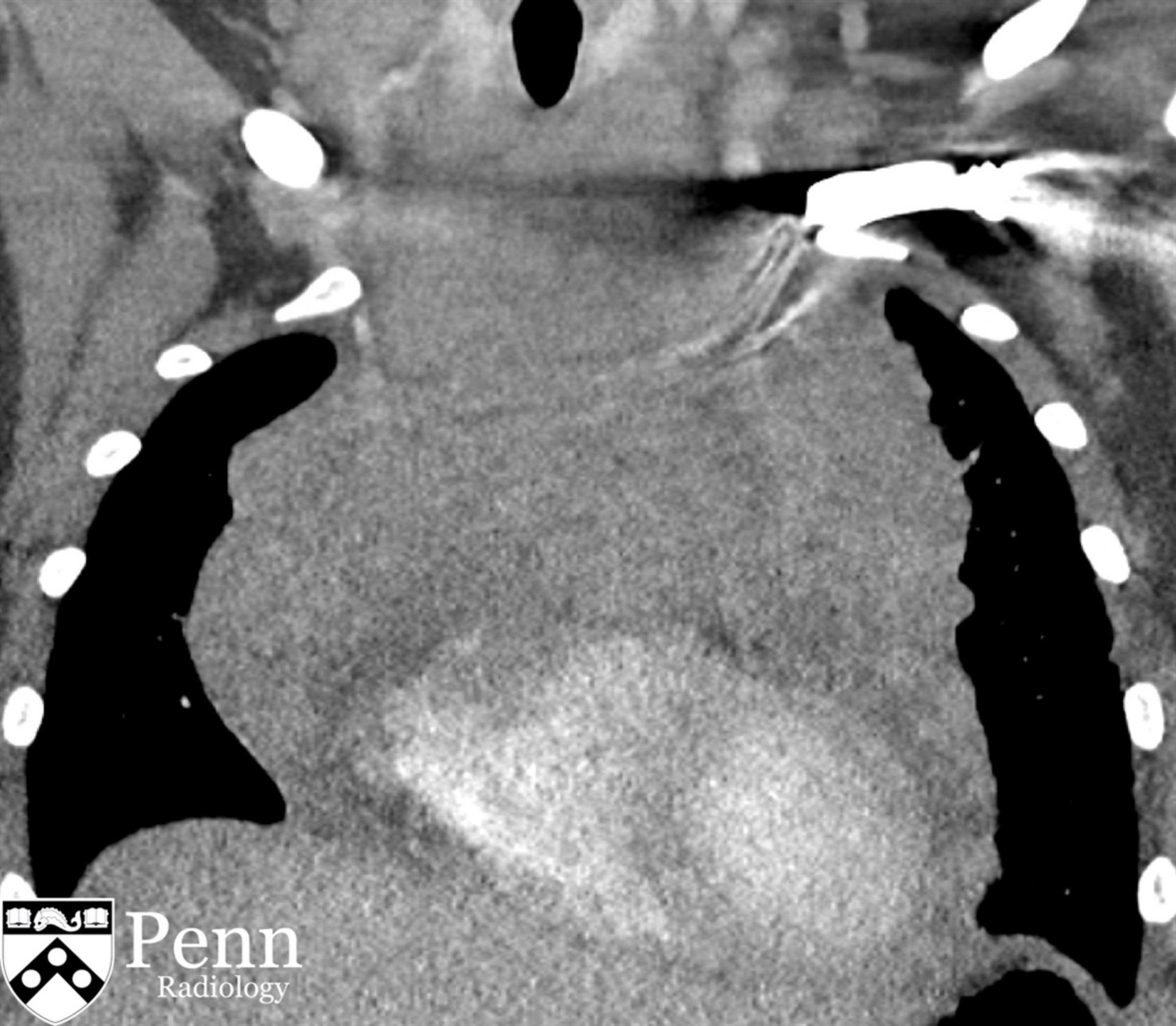
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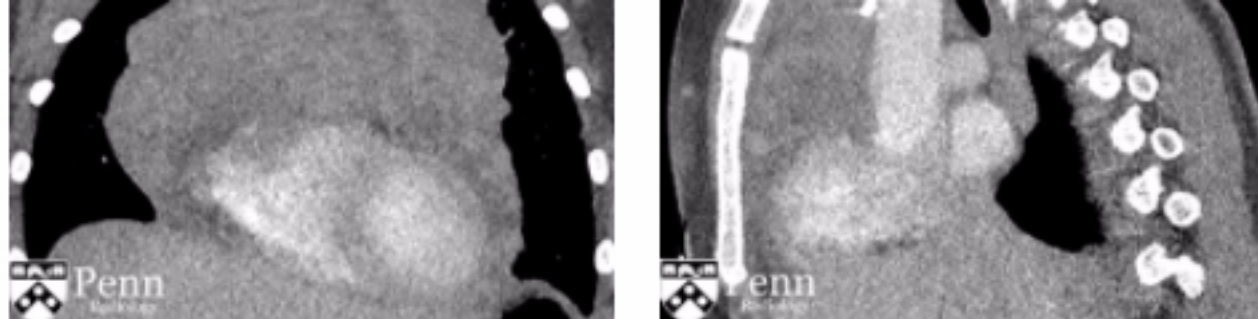


Which of the following is not included in the differential diagnosis?

- ☐ Thymic neoplasm
- ☐ Thymic hyperplasia
- ☐ Lymphoma
- ☐ Germ cell neoplasm

The question above accounts for 33% of your total score for this case.

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Which of the following is not included in the differential diagnosis?

☐ Thymic neoplasm

☒ Thymic hyperplasia (correct!)

☐ Lymphoma

☐ Germ cell neoplasm

The question above accounts for 33% of your total score for this case.

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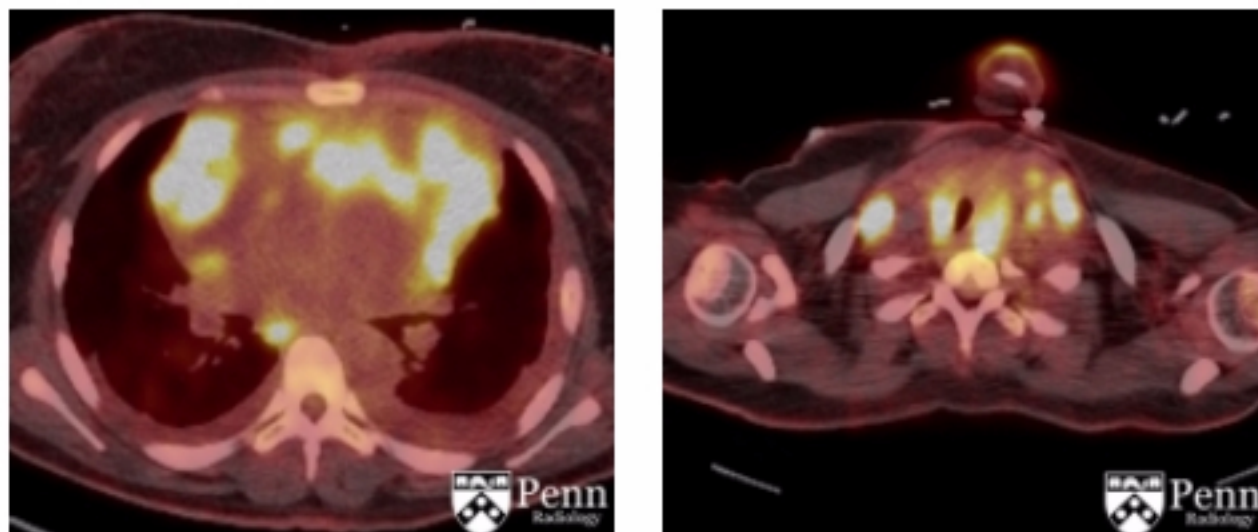
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PET/CT images

A biopsy of the mediastinal mass was obtained, and initial pathology revealed a neoplasm with thymic origin.

An F-18 FDG PET/CT scan also was obtained. Click images to enlarge.



High-level increased **FDG** uptake helps differentiate thymic carcinoma from thymoma.

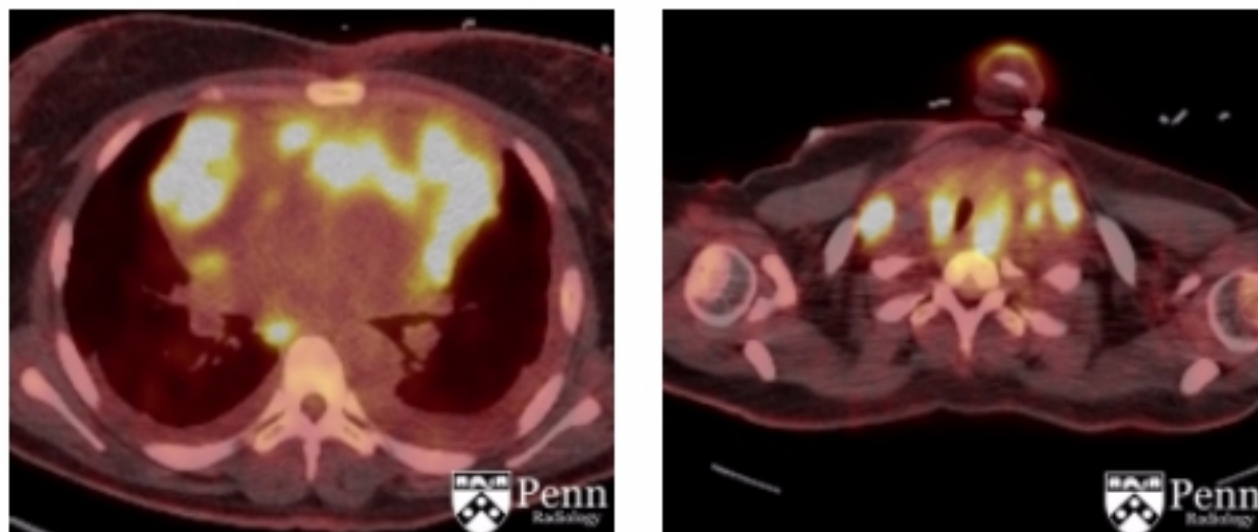
☐ True

☐ False

PET/CT images

A biopsy of the mediastinal mass was obtained, and initial pathology revealed a neoplasm with thymic origin.

An F-18 FDG PET/CT scan also was obtained. Click images to enlarge.



High-level increased **FDG** uptake helps differentiate thymic carcinoma from thymoma.

☒ True (correct!)

☐ False



Findings

- The chest radiographs show a large anterior mediastinal mass.
- CT confirms the presence of a large anterior mediastinal mass that is somewhat lobulated. Bilateral cervical lymphadenopathy also is shown.
- F-18 FDG PET/CT shows high-level heterogeneous FDG uptake in the mediastinal mass and the cervical lymphadenopathy.

Differential diagnosis

- Thymic neoplasm (thymoma, thymic carcinoid, thymic carcinoma)
- Germ cell neoplasm (teratoma, seminoma, non-seminomatous germ cell tumor)
- Lymphoma

Diagnosis: Thymic carcinoma, confirmed by biopsy

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Key points

Thymic carcinoma

Background

- Thymic tumors account for approximately 15% of all mediastinal tumors.
- Thymic epithelial tumors are the most common anterior mediastinal mass in adults.
 - Thymomas are the most common.
 - 20% are thymic carcinomas.
- Mean age at presentation is 50 years old.
- Thymic carcinomas are much more aggressive than invasive thymomas.
 - 5% of invasive thymomas have distant metastases at presentation.
 - More than 50% of thymic carcinomas have distant metastases at presentation.
- They rarely cause paraneoplastic syndromes, such as myasthenia gravis, compared with thymomas.

Imaging findings

- Chest radiographs: Radiographs will show an enlarged anterior mediastinum.
- CT:
 - CT will show an enhancing multilobulated mass.
 - May contain areas of hypoattenuation.
 - May contain scattered calcifications.
 - Difficult to distinguish from thymoma.
- F-18 FDG PET/CT:

Imaging findings

- Chest radiographs: Radiographs will show an enlarged anterior mediastinum.
- CT:
 - CT will show an enhancing multilobulated mass.
 - May contain areas of hypoattenuation.
 - May contain scattered calcifications.
 - Difficult to distinguish from thymoma.
- F-18 FDG PET/CT:
 - F-18 FDG PET/CT may be useful in differentiating thymic carcinoma from other thymic neoplasms.
 - Standardized uptake values (SUVs) have been reported to be significantly higher in thymic carcinomas than in thymomas.
 - With an SUV cutoff value of 5.0, F-18 FDG PET/CT has a reported specificity of 92% and sensitivity of 85% for differentiating thymic carcinoma from thymoma.
 - There is no significant SUV difference to distinguish noninvasive from invasive thymoma.

References

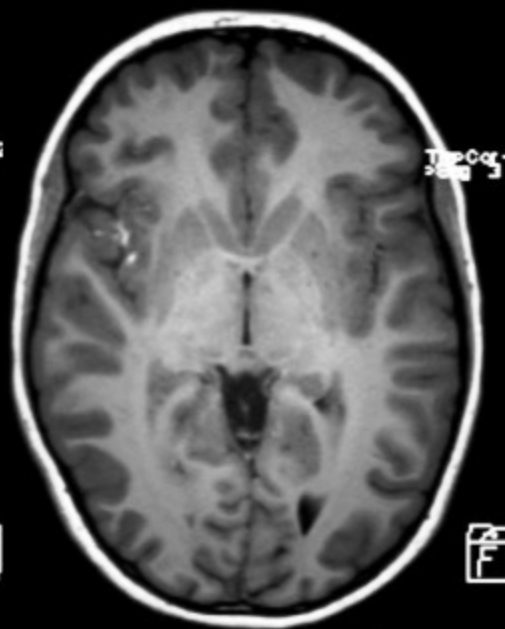
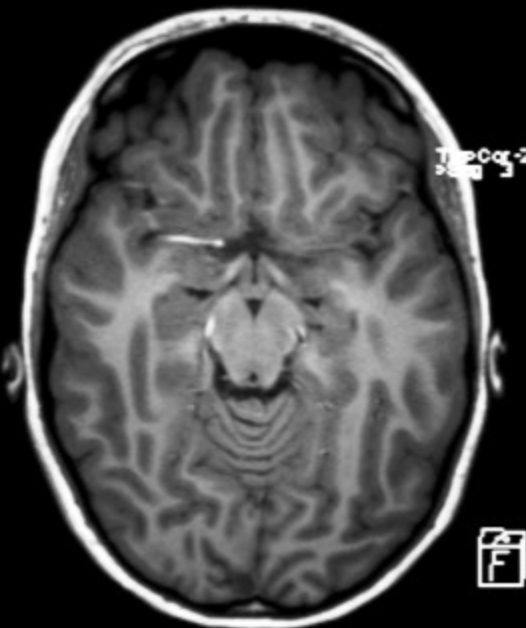
1. Nasseri F, Eftekhari F. Clinical and radiologic review of the normal and abnormal thymus: Pearls and pitfalls. *Radiographics*. 2010;30(2):413-428.
2. Nishino M, Ashiku SK, Kocher ON, Thurer RL, Boisselle PM, Hatabu H. The thymus: A comprehensive review. *Radiographics*, 2006;26(2):335-348.
3. Quagliano PV. Thymic carcinoma: Case reports and review. *J Thorac Imaging*. 1996;11(2):66-74.

History and MR images

Our appreciation is extended to Drs. Jeffrey Rudie and Karuna Shekdar, University of Pennsylvania Department of Radiology, for contributing this case.

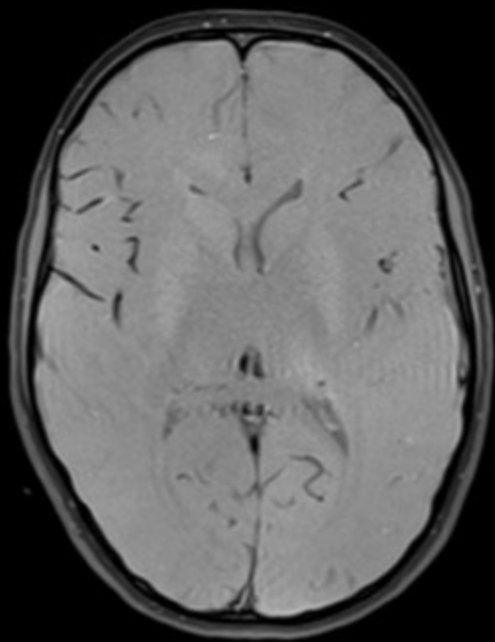
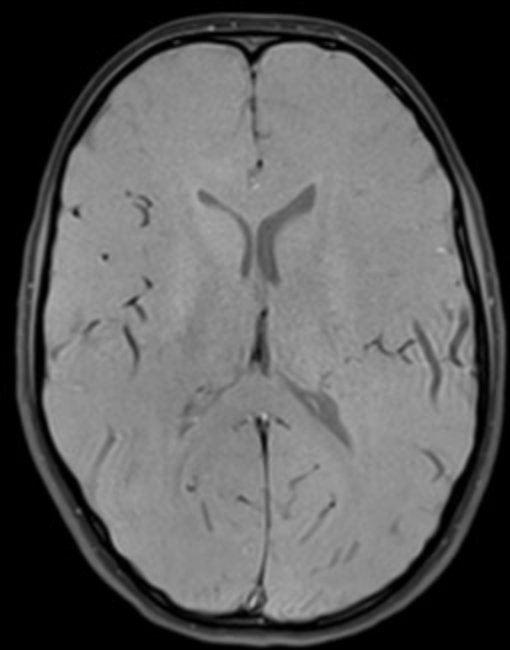
History: A 9-year-old boy presents with recurrent episodes of right-sided numbness and weakness. There is a concern for stroke/transient ischemic attack (TIA). The patient has no known medical conditions.

A brain MRI scan without contrast was obtained for further evaluation. Click images below to enlarge. In order: axial 3D T1-weighted gradient-recalled echo, axial T1-weighted spin-echo, axial and coronal T2-weighted fluid-attenuated inversion-recovery (FLAIR), axial diffusion-weighted (DWI), and apparent diffusion coefficient (ADC) images.



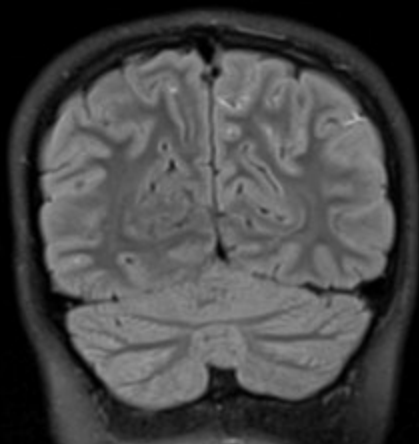
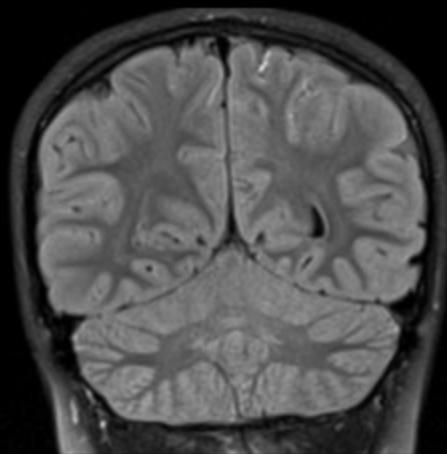
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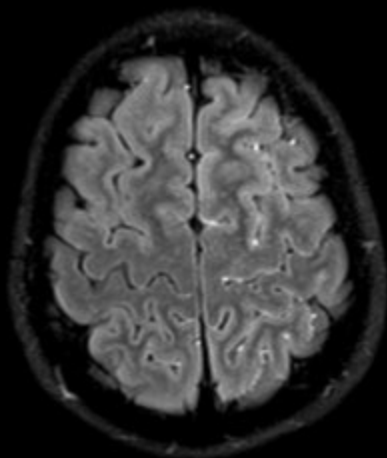
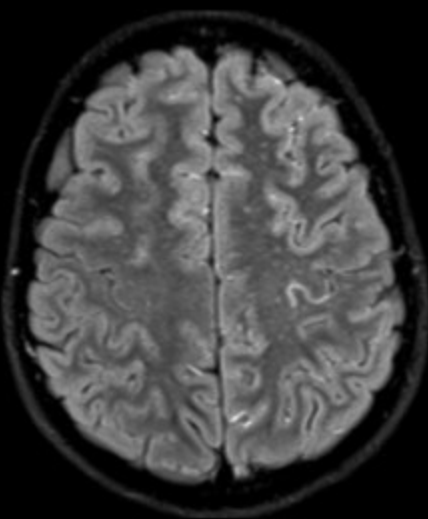
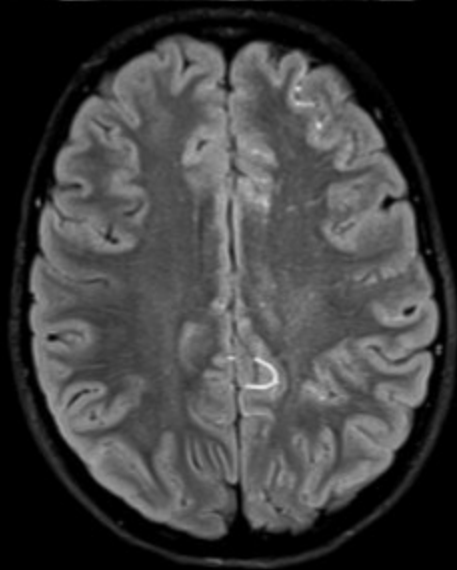


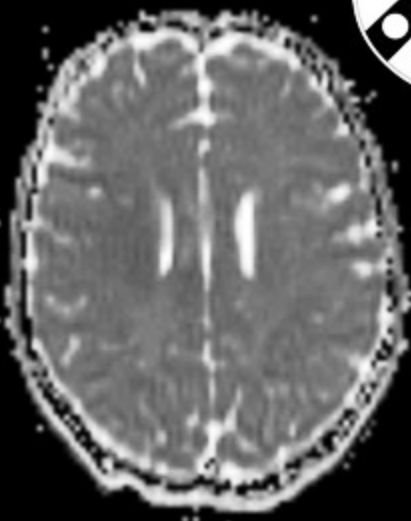
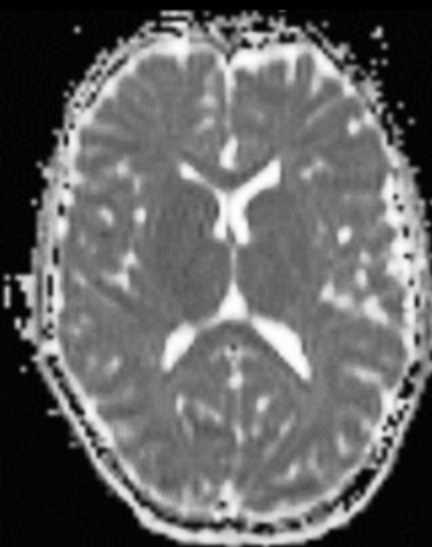
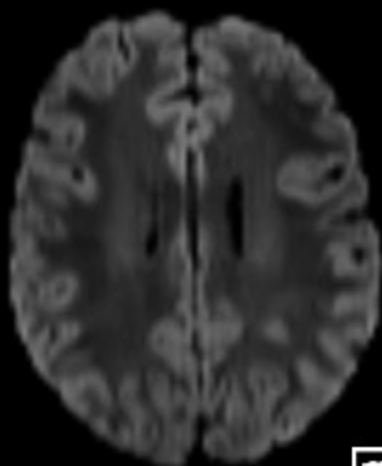
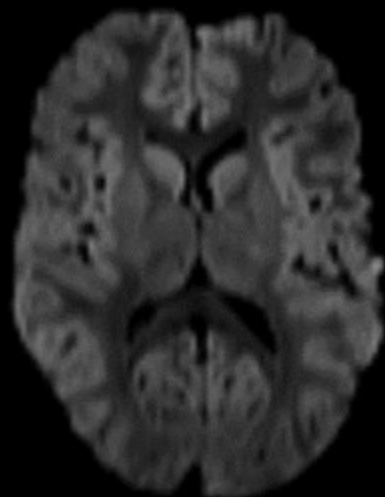
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There is abnormal FLAIR signal.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

There is abnormal restricted diffusion.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

There is asymmetry of the intracranial vasculature.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

Based on the findings, MR angiography (MRA) would be appropriate.

There is abnormal FLAIR signal.

☒ True (correct!)

☐ False

The question above accounts for 15% of your total score for this case.

There is abnormal restricted diffusion.

☐ True

☒ False (correct!)

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☐ True

☐ False

The question above accounts for 14% of your total score for this case.

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☐ False

The question above accounts for 14% of your total score for this case.

Based on the findings, MR angiography (MRA) would be appropriate.

☒ True (correct!)

☐ False

The question above accounts for 14% of your total score for this case.

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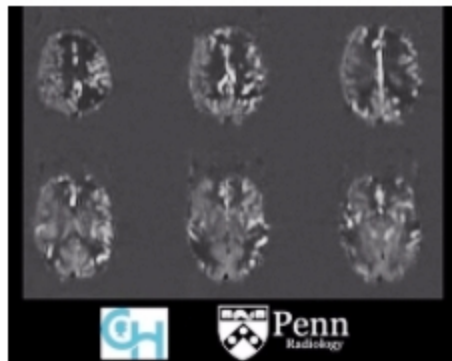
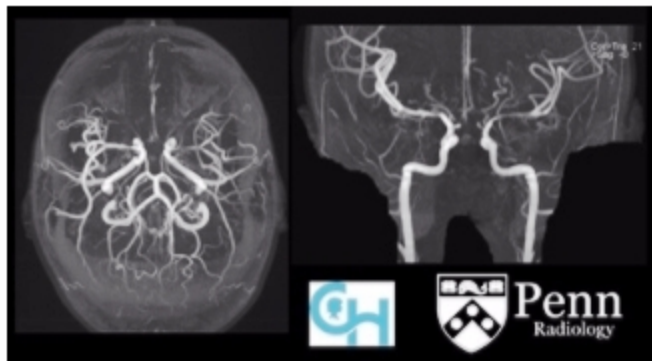
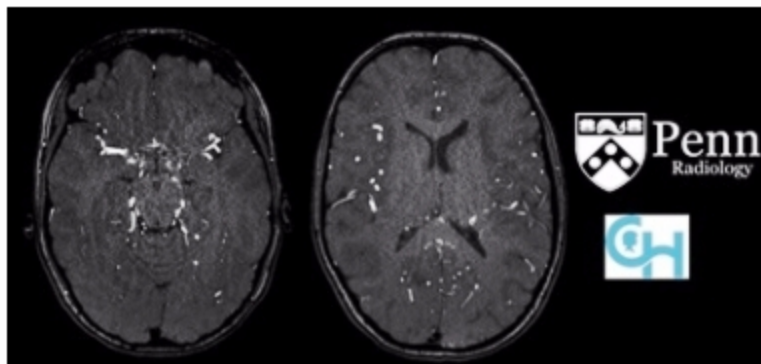
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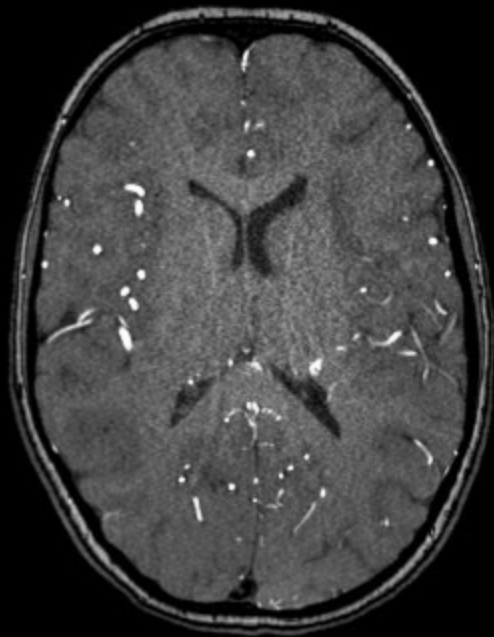
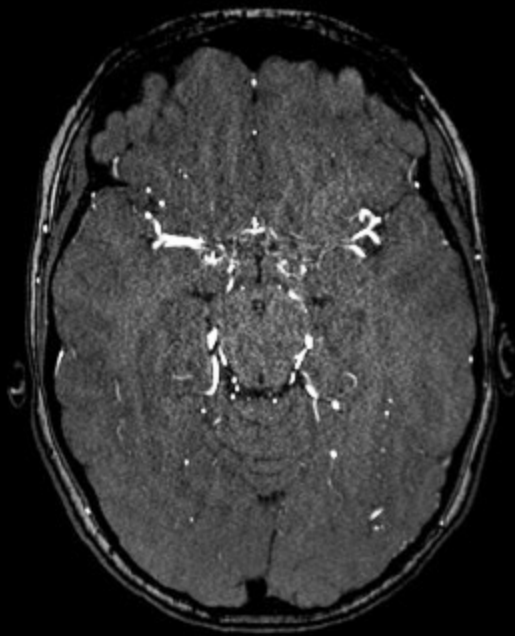
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Additional images

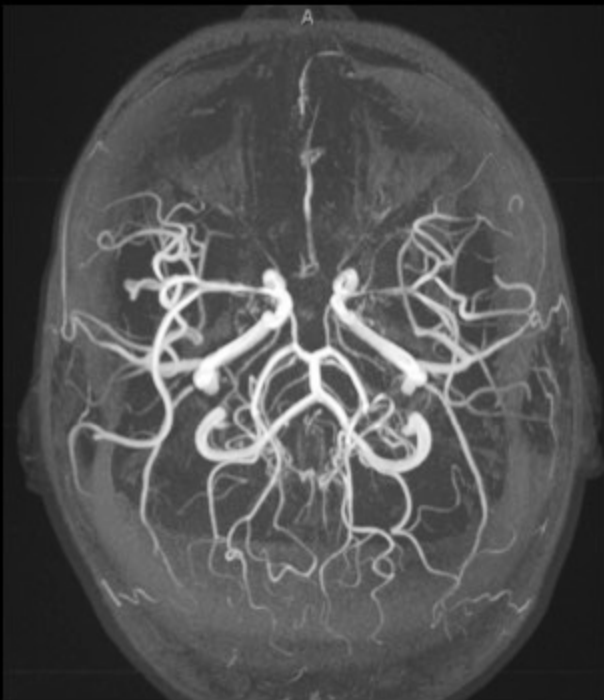
Vascular imaging was deemed medically necessary. Therefore, 3D time-of-flight MRA through the circle of Willis was performed. Axial MRA source images and 3D reconstructions of the circle of Willis are shown below. In addition, arterial spin-labeled (ASL) perfusion was performed, and axial perfusion images are shown below. Click to enlarge.



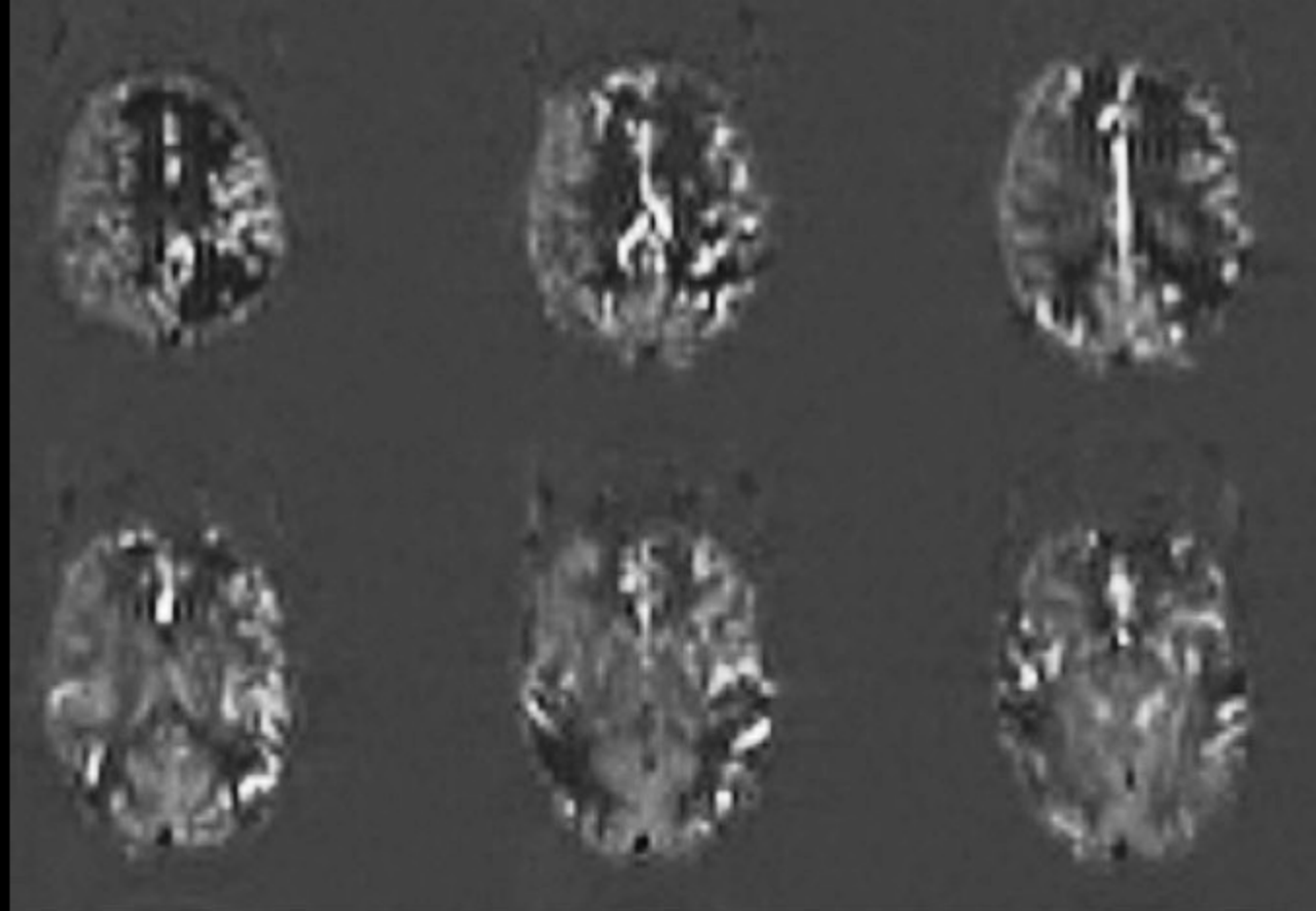


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There is asymmetric perfusion.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

Given that the patient has no known medical conditions, what is the most likely etiology of the lesions?

☐ Traumatic

☐ Inflammatory

☐ Idiopathic vascular

☐ Infectious

☐ Neoplastic

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Autoimmune vasculitis

There is asymmetric perfusion.

☒ True (correct!)

☐ False

The question above accounts for 14% of your total score for this case.

Given that the patient has no known medical conditions, what is the most likely etiology of the lesions?

☐ Traumatic

☐ Inflammatory

☒ Idiopathic vascular (correct!)

☐ Infectious

☐ Neoplastic

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Autoimmune vasculitis

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

- ☐ Autoimmune vasculitis
- ☐ Idiopathic moyamoya disease
- ☐ Atherosclerosis
- ☐ Infectious meningitis

The question above accounts for 14% of your total score for this case.

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The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Autoimmune vasculitis

☒ Idiopathic moyamoya disease (correct!)

☐ Atherosclerosis

☐ Infectious meningitis

The question above accounts for 14% of your total score for this case.

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Findings

- **Brain MRI:** There is no acute infarct, hemorrhage, or mass effect of hydrocephalus. There is abnormal FLAIR hyperintensity within the sulci diffusely, left greater than right, suggestive of slow vascular flow. There is delayed tracer seen within the left hemisphere on the ASL images.
- **Brain MRA:** There is narrowing of the internal carotid artery (ICA) terminus, and proximal M1 segments bilaterally, greater on the left. There is marked narrowing of the bilateral A1 segments with reconstitution of diminutive distal anterior cerebral arteries (ACAs) bilaterally. There are prominent collateral vessels noted in the perimesencephalic and middle cerebral artery (MCA) cisterns bilaterally, right greater than left. No aneurysms are seen.

Differential diagnosis

- Idiopathic moyamoya disease
- Fibromuscular dysplasia
- Neurofibromatosis 1
- Sickle cell disease
- Atherosclerosis
- Antiphospholipid syndrome
- Bacterial or tuberculous meningitis

Diagnosis: Idiopathic moyamoya disease

9-year-old boy with right-sided numbness, weakness

CASE OUTLINE

Page 4 of 4

Key points

Moyamoya disease

Pathogenesis

Moyamoya disease is an idiopathic, noninflammatory, progressive disease characterized by steno-occlusive changes in the intracranial circulation, leading to neurological compromise. Moyamoya syndrome or the moyamoya pattern/phenomenon can be due to many conditions that can lead to occlusion of the circle of Willis with formation of collaterals, including atherosclerosis, sickle cell disease, neurofibromatosis 1, and connective tissue diseases and infections. The mechanism of idiopathic moyamoya disease is unclear, but pathologic studies show intimal thickening (similar to fibromuscular dysplasia) and medial thinning without inflammatory change. The disease progresses through several stages, including the development of collateral networks, which are ultimately not able to compensate for the progressive occlusion. There is a genetic component given that approximately 15% of cases are familial, and there is a higher prevalence in individuals with Down syndrome.

Epidemiology

Moyamoya disease has a bimodal distribution, seen in early childhood (approximately 10 years of age) and middle age (35-45 years). It was initially described in Japanese patients, in which it is still most common (with an estimated prevalence of approximately 9.1 in 100,000), although it has been found to affect all races and with a preponderance in women compared with men (female-to-male ratio of 1.9:1).

Clinical presentation

In children, TIAs and ischemic strokes in watershed distributions, often causing hemiparesis, are the most common presentation, often occurring after episodes of crying or hyperventilation. In Asian countries, moyamoya disease is the most common cause of TIA/stroke in children. Additional symptoms include intellectual decline, seizures (5%), headaches (approximately 20%), and involuntary movements (4%). In adults, hemorrhagic strokes in the affected vascular distribution are more common due to tiny friable vessels and rupture of tiny aneurysms.

Diagnosis

Other systemic causes of moyamoya patterns must first be excluded. Steno-occlusive disease at the terminal ICA should be present bilaterally as seen on MRI/MRA. For unilateral cases, catheter angiography is required for the diagnosis.

Diagnosis

Other systemic causes of moyamoya patterns must first be excluded. Steno-occlusive disease at the terminal ICA should be present bilaterally as seen on MRI/MRA. For unilateral cases, catheter angiography is required for the diagnosis.

Imaging features

- Usually bilateral but it is often asymmetric and is unilateral in approximately 18% of cases
- The distal ICAs and MCAs are most classically involved (approximately 90% of cases), with the ACA territory affected in approximately 52% of cases.
- Posterior cerebral artery (PCA) involvement is less common (10% to 29%) and is associated with a worse prognosis.
- A net of small abnormal collateral vessels is usually seen as multiple tortuous flow voids on T1/T2 sequences in the region of the lenticulostriate, thamo-perforating, leptomenigeal, and dural arteries.
- The net of abnormal vessels gives the classic “puff of smoke” appearance on catheter angiography and is considered diagnostic, but this sign is less often seen on CT or MRA.
- Contrast-enhanced MRI may show marked leptomenigeal enhancement along the cortical sulci, secondary to the development of collateral parenchymal-perforating vessels (so-called moyamoya vessels), known as the “ivy sign.”

- As in this case, the ivy sign can also be seen on FLAIR imaging as hyperintense signal in the subarachnoid space, thought to reflect slow flow through an engorged pial network of congested collateral vessels.
- After surgical bypass treatment, the amount of leptomeningeal enhancement will often decrease.
- In adults, multiple foci of microbleeds and prominent deep medullary veins may be seen on susceptibility sequences.

Treatment and prognosis

- The natural progression of the disease is progressive occlusion, leading to neurological deterioration.
- Medical treatments including aspirin, mannitol, and steroids are largely unsuccessful.
- Surgical revascularization to bypass occlusive segments is the mainstay of treatment.
- In pediatric patients, the treatment of choice is encephaloduroarteriosynangiosis (EDAS), which involves transposition of a scalp artery to the surface of the brain.
- In adults, external carotid artery to middle cerebral artery anastomoses are most often performed.

References

1. Kim JS. Moyamoya disease: Epidemiology, clinical features, and diagnosis. *J Clin Neurol*. 2012;10(1):2-11.

48-year-old woman with abdominal pain

CASE OUTLINE

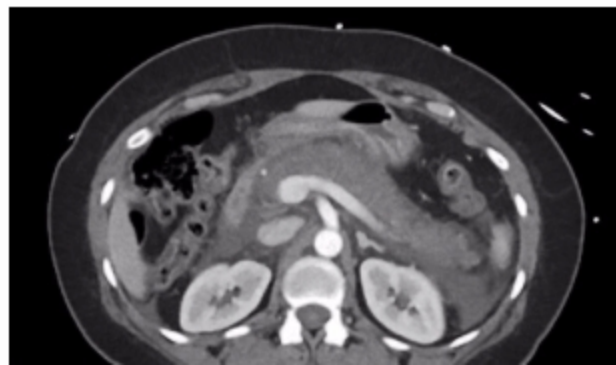
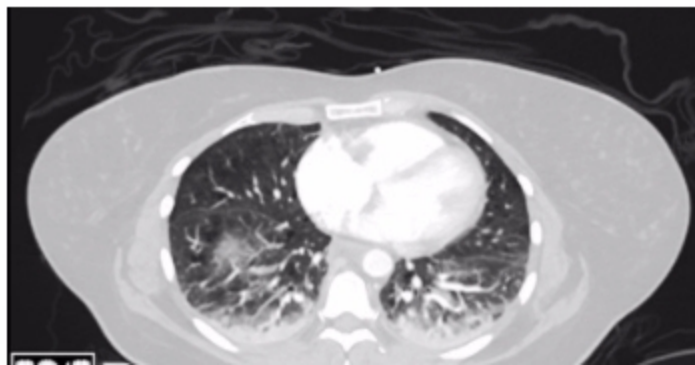
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History and images

Our appreciation is extended to Dr. Erica Alexander, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 48-year-old woman presents to the emergency department with abdominal pain, nausea, and vomiting. The patient has a history of gallstone pancreatitis and underwent cholecystectomy eight months prior.

Contrast-enhanced CT images of the abdomen and pelvis are shown below. Click to enlarge.

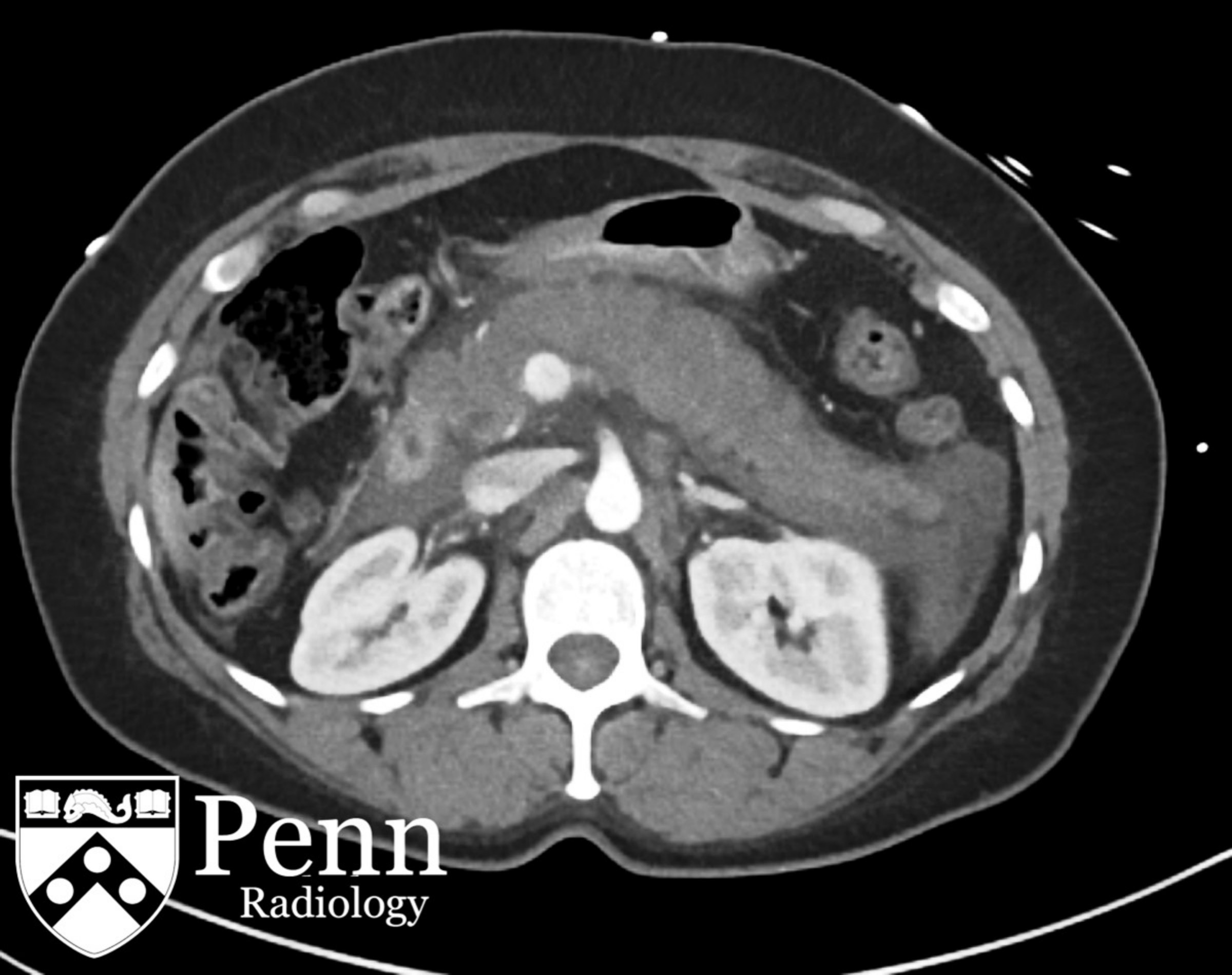




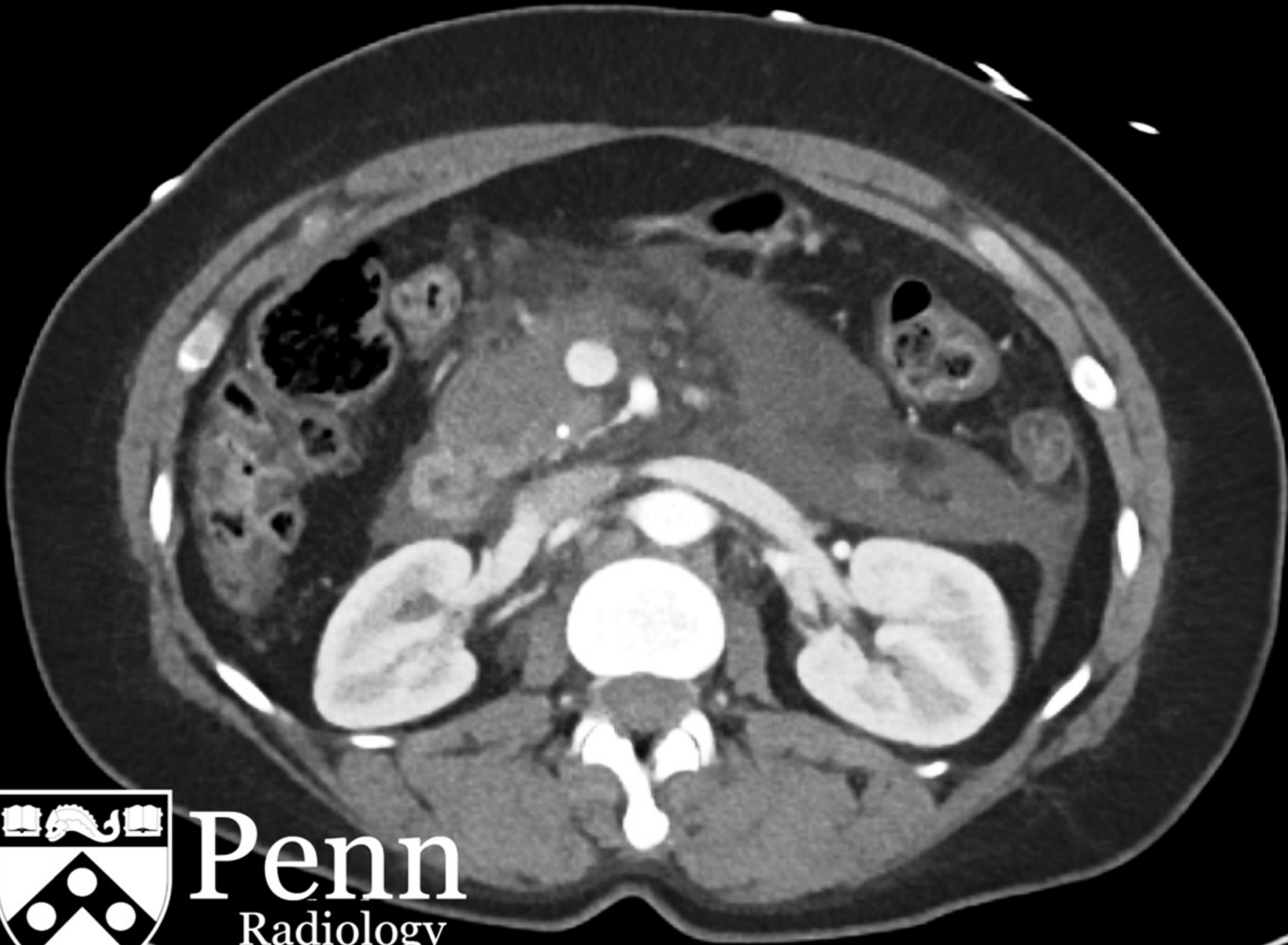
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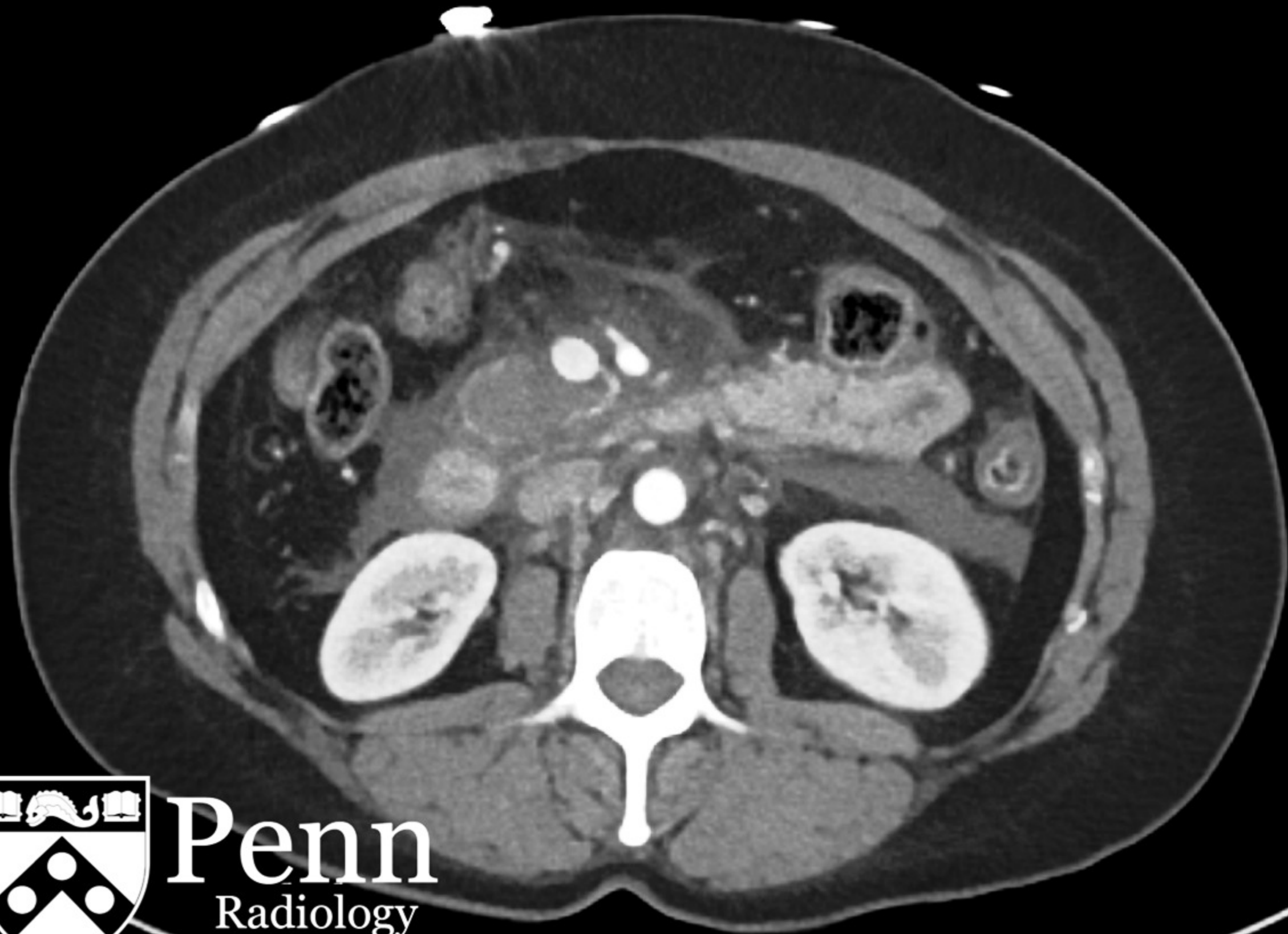
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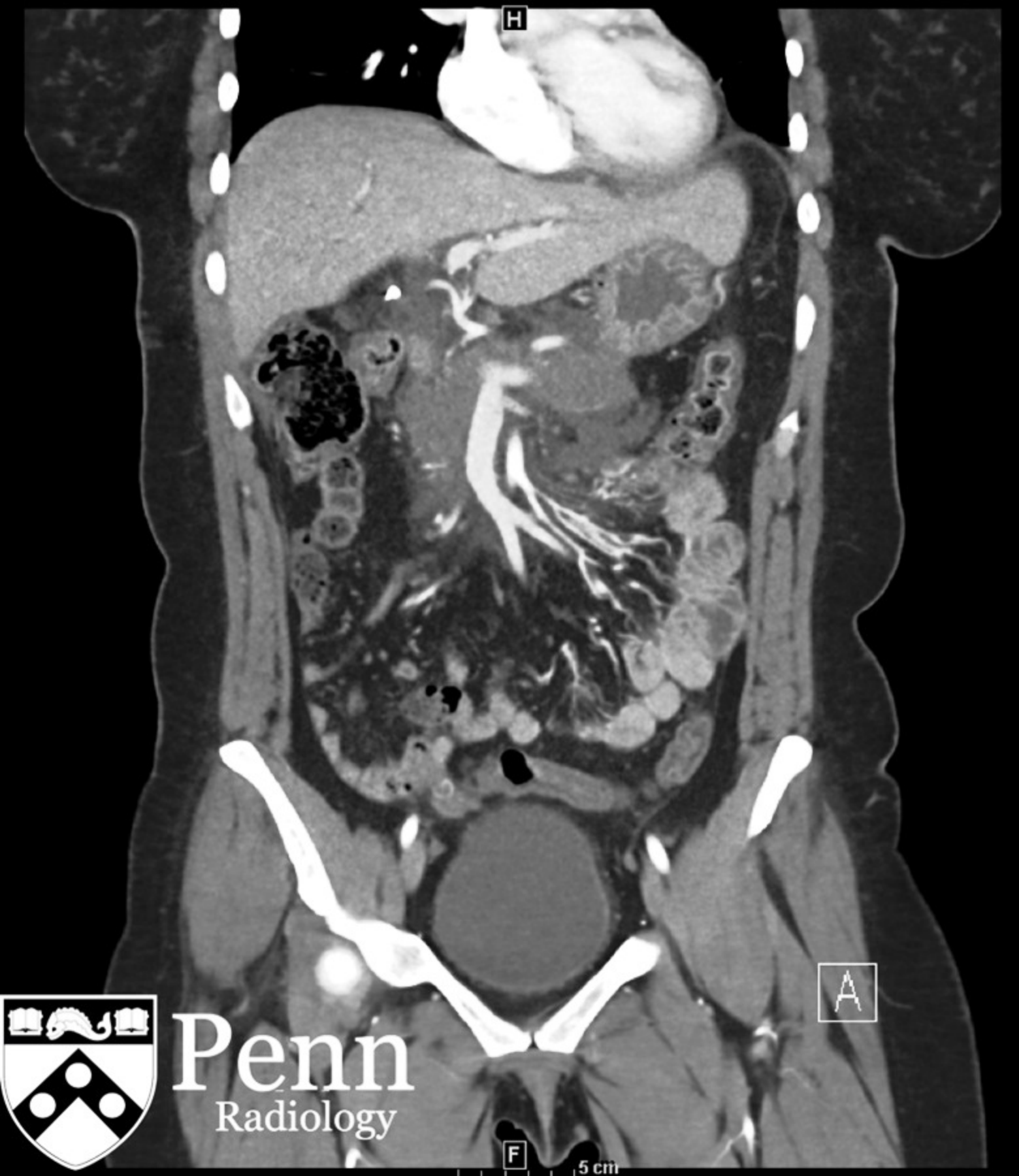
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Which abdominal organ appears abnormal?

☐ Left adrenal

☐ Pancreas

☐ Colon

☐ Bladder

The question above accounts for 20% of your total score for this case.

Which lab value would be helpful in securing the diagnosis?

☐ White blood cell count

☐ Hematocrit

☐ Creatinine

☐ Lipase

The question above accounts for 20% of your total score for this case.

Which abdominal organ appears abnormal?

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☒ Pancreas (correct!)

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☐ Bladder

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Which lab value would be helpful in securing the diagnosis?

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The question above accounts for 20% of your total score for this case.

The question above accounts for 20% of your total score for this case.

Based on the provided images, what is the most likely diagnosis?

☐ Acute respiratory distress syndrome

☐ Multifocal pneumonia

☐ Pancreatic adenocarcinoma

☐ Pancreatitis

The question above accounts for 20% of your total score for this case.

What is the most likely diagnosis for the basilar lung opacities?

☐ Atelectasis

☐ Multifocal pneumonia

☐ Pulmonary edema

☐ Acute respiratory distress syndrome

The question above accounts for 20% of your total score for this case.

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☐ Acute respiratory distress syndrome

The question above accounts for 20% of your total score for this case.

The question above accounts for 20% of your total score for this case.

Which of the following findings would not suggest complicated pancreatitis?

☐ Free fluid

☐ Central necrosis

☐ Pseudoaneurysm

☐ Abscess formation

The question above accounts for 20% of your total score for this case.

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Findings

There is bibasilar atelectasis in the lungs, without evidence of pleural effusion. The pancreas is enlarged and edematous, and there is marked peripancreatic fluid along with fat stranding, in keeping with pancreatitis. There is no evidence of an organized/drainable collection. There are prominent mesenteric lymph nodes surrounding the pancreas, which are likely reactive in the setting of acute pancreatitis.

Differential diagnosis

- Acute pancreatitis
- Pancreatic ductal adenocarcinoma
- Autoimmune pancreatitis
- Peptic ulcer disease
- Pancreatic lymphoma
- Shock pancreas

Diagnosis: Acute pancreatitis

Discussion

Acute pancreatitis

Pathophysiology

Acute pancreatitis is caused by acute inflammation of the pancreas with possible inflammatory involvement of other surrounding tissues or organs. The most common cause of acute pancreatitis is gallstone disease. Other causes include excess alcohol use, ingested medicines, neoplasm, endoscopic retrograde cholangiopancreatography (ERCP), anatomic variants, hypertriglyceridemia, or hypercalcemia.

There are two major subtypes of pancreatitis: interstitial edematous pancreatitis, also known as uncomplicated pancreatitis, and necrotizing pancreatitis.

Epidemiology

An estimated 300,000 hospital admissions each year are due to acute pancreatitis. The overall mortality rate is 5% for acute pancreatitis, with interstitial edematous pancreatitis having a much better prognosis.

Clinical presentation

Symptoms generally begin with upper abdominal pain that extends to the back. The pain increases with eating. Patients also generally present with a swollen/tender abdomen, nausea and vomiting, fever, and tachycardia. Physical exam findings suggestive of hemorrhage include Cullen's sign, or periumbilical bruising, and the Grey Turner's sign, or flank bruising.

Elevated amylase and lipase levels are highly specific for pancreatitis.

Complications of acute pancreatitis include acute peripancreatic fluid collections, pseudocysts, necrosis, pancreatic abscess, hemorrhage, pseudoaneurysm, splenic or portal vein thrombosis, and fistula formation.

Imaging features

- **CT:** Interstitial edematous pancreatitis generally presents on CT with an enlarged and edematous pancreas with loss of the normal fat lobulation. There is generally peripancreatic fat stranding, edema, and free fluid. Mild pancreatitis may not demonstrate any abnormalities on CT imaging. Necrotizing pancreatitis presents with parenchymal necrosis, which can be nonenhancing or severely hypoenhancing. There is usually a greater degree of peripancreatic fluid and edema than what is seen with uncomplicated pancreatitis.
- **Ultrasound:** Ultrasound can be used to identify gallstones as a cause for pancreatitis or identify complications, including thrombosis or areas of hypoechoic necrosis. The pancreas will generally appear enlarged and hypoechoic with adjacent free fluid and blurring.
- **MRI:** The pancreas will appear enlarged with increased T2-weighted signal intensity and with low signal on T1-weighted imaging, secondary to edema. On T1-weighted contrast-enhanced images, the appearance will be similar to that on contrast-enhanced CT. MR cholangiopancreatography (MRCP) can be used to evaluate the pancreatic duct.

Treatment

Treatment of pancreatitis is generally supportive. Patients are generally hospitalized, kept aggressively rehydrated, provided pain control, and withheld from oral intake of food and fluids (NPO) for the first 48 hours, which can be followed by enteral feeding.

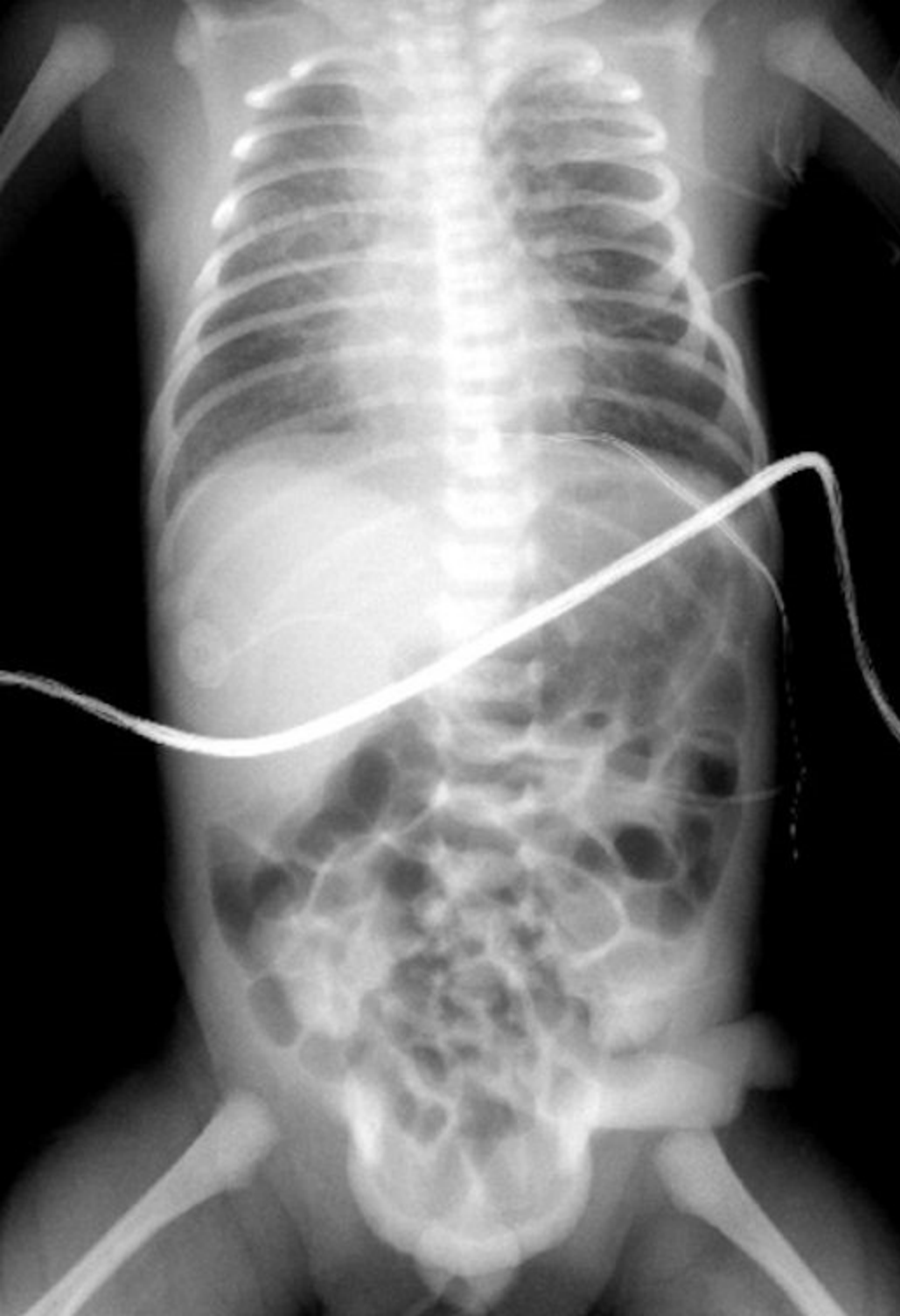
Acute pancreatitis caused by gallstones should be treated with cholecystectomy. Infected pancreatic necrosis may be treated with surgical debridement. Asymptomatic or uninfected fluid collections do not require intervention.

History and radiograph

Our appreciation is extended to Dr. Amy Frkas, University of Mississippi Medical Center in Jackson, MS, for contributing this case.

History: A neonate born at 38 weeks of gestation undergoing imaging. The neonate was born to a 27-year-old mother by cesarean section after failed induction of labor. The pregnancy was complicated by the mother's gestational diabetes and tobacco use.

A chest and kidney, ureter, and bladder (KUB) radiograph is shown below. [Click to enlarge.](#)



What is the salient finding?

- ☐ Abdominal mass
- ☐ Small-bowel obstruction
- ☐ Skeletal dysplasia
- ☐ Widening of the pubic symphysis

The question above accounts for 15% of your **total score** for this case.

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What is the salient finding?

- ☐ Abdominal mass
- ☐ Small-bowel obstruction
- ☐ Skeletal dysplasia
- ☒ Widening of the pubic symphysis (correct!)

The question above accounts for 15% of your total score for this case.

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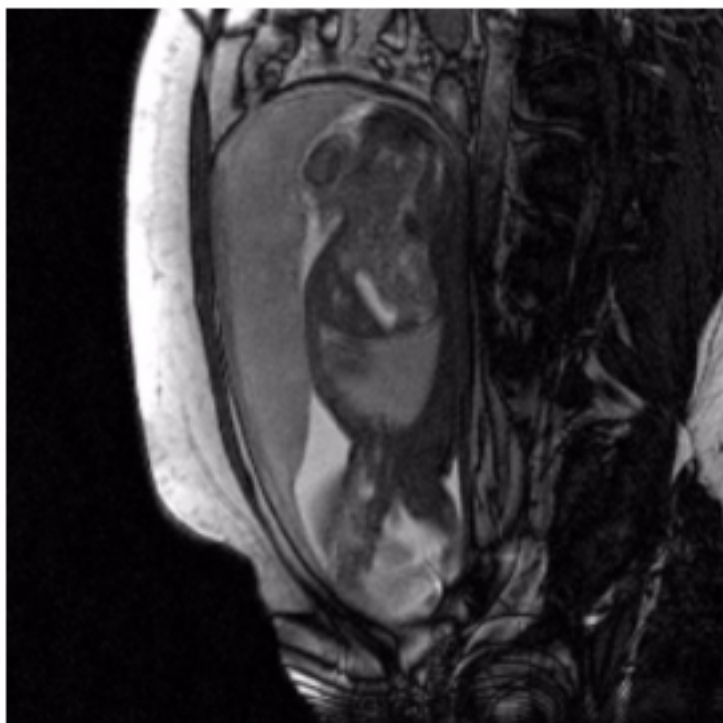
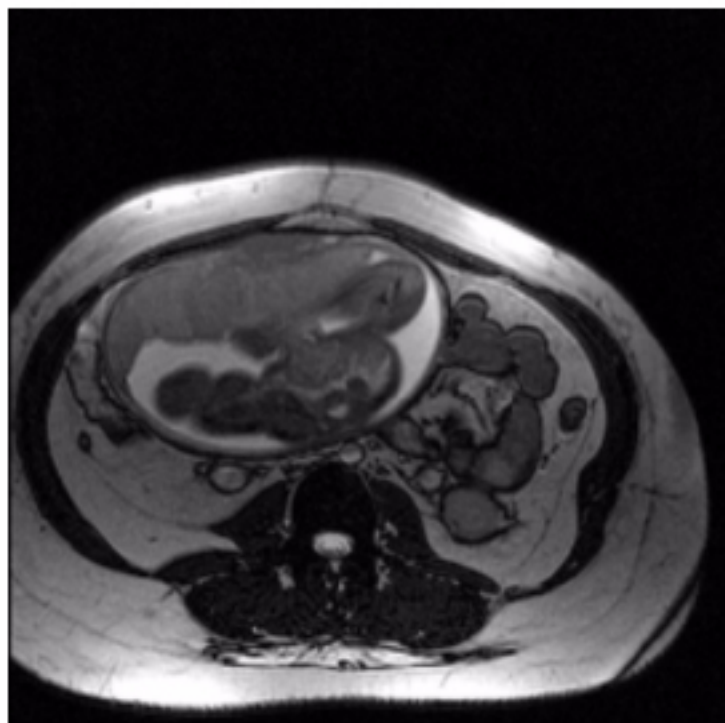
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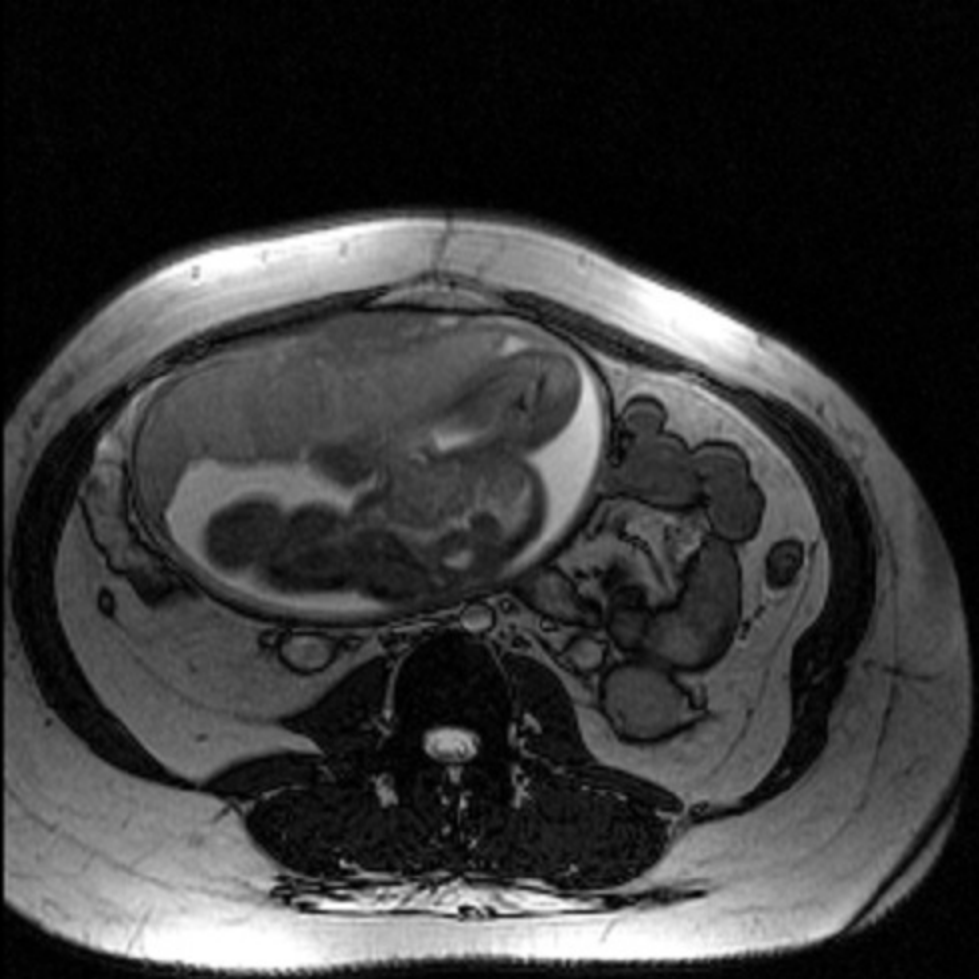
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MR images

The mother had undergone an MRI scan at 27 weeks of gestation. Axial and sagittal T2-weighted true fast images with steady-state precession (true FISP) are shown below. Click to enlarge.









What is the diagnosis?

- ☐ Prune belly syndrome
- ☐ Cleidocranial dysostosis
- ☐ Bladder exstrophy
- ☐ Patent urachus

The question above accounts for 15% of your total score for this case.

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What is the diagnosis?

- ☐ Prune belly syndrome
- ☐ Cleidocranial dysostosis
- ☒ Bladder exstrophy (correct!)
- ☐ Patent urachus

The question above accounts for 15% of your total score for this case.

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Findings

- Chest/KUB radiograph: There is widening of the pubic symphysis.
- Fetal MRI: MRI demonstrates tissue thickening/abnormality along the lower anterior midline abdominal wall.

Differential diagnosis

- OEIS complex
- Prune belly syndrome
- Cleidocranial dysostosis
- Bladder exstrophy
- Patent urachus

Diagnosis: Bladder exstrophy

Additional questions

This anomaly is associated with elevated maternal alpha fetoprotein.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

This finding is more common in females.

☐ True

☐ False

Neonate undergoing imaging

CASE OUTLINE

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Additional questions

This anomaly is associated with elevated maternal alpha fetoprotein.

☒ True (correct!)

☐ False

The question above accounts for 14% of your total score for this case.

This finding is more common in females.

☐ True

☒ False (correct!)

The question above accounts for 14% of your total score for this case.

OEIS complex does NOT include which of the following:

☐ Omphalocele

☐ Ear abnormalities

☐ Spinal abnormalities

☐ Imperforate anus

☐ Cloacal exstrophy

The question above accounts for 14% of your total score for this case.

Which of the following congenital abnormalities is associated with bladder exstrophy?

☐ Microcephaly

☐ Coloboma

☐ Inguinal hernia

☐ Clubfoot

☐ Hypospadias

The question above accounts for 14% of your total score for this case.

OEIS complex does NOT include which of the following:

☐ Omphalocele

☒ Ear abnormalities (correct!)

☐ Spinal abnormalities

☐ Imperforate anus

☐ Cloacal exstrophy

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Which of the following congenital abnormalities is associated with bladder exstrophy?

☐ Microcephaly

☐ Coloboma

☒ Inguinal hernia (correct!)

☐ Clubfoot

☐ Hypospadias

The question above accounts for 14% of your total score for this case.

The diagnosis of bladder exstrophy is usually made postnatally.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

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The question above accounts for 14% of your total score for this case.

The diagnosis of bladder exstrophy is usually made postnatally.

☒ True (correct!)

☐ False

[\[Explain this Answer\]](#)

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Key points

Bladder exstrophy

- Bladder exstrophy is a congenital abdominal wall defect that occurs two to three times more commonly in males than females.
- Widening of the pubic symphysis, or the manta ray sign, is found with bladder exstrophy.
- Elevated alpha fetoprotein on the maternal quad screen may be the first indication of bladder exstrophy. Nonvisualization of the bladder on ultrasound is an additional sign of bladder exstrophy; however, the diagnosis can be difficult to diagnose sonographically. As low as 25% of patients with bladder exstrophy have a diagnosis made antenatally.
- Bladder exstrophy can be associated with cryptorchidism, inguinal hernias, and epispadias.
- OEIS complex, which was not present in this case, includes the congenital anomalies omphalocele, bladder/cloacal exstrophy, imperforate anus, and spinal anomalies.
- Cloacal exstrophy is a more extensive abdominal wall defect that includes bladder exstrophy, omphalocele, and an abdominal wall defect.
- Additional congenital abnormalities that result in widening of the pubic symphysis include prune belly syndrome, cleidocranial dysostosis, and osteogenesis imperfecta. Open book pelvic fractures also can result in the widening of the pubic symphysis.



76-year-old woman with vaginal spotting

CASE OUTLINE

Page 1 of 4

History and ultrasound images

Our appreciation is extended to Dr. Bryan Chang, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 76-year-old woman presents to her primary care physician with intermittent vaginal spotting. Additional history is temporarily withheld.

An ultrasound scan of the pelvis was performed. Sagittal and coronal grayscale images of the uterus are shown below. Click to enlarge.



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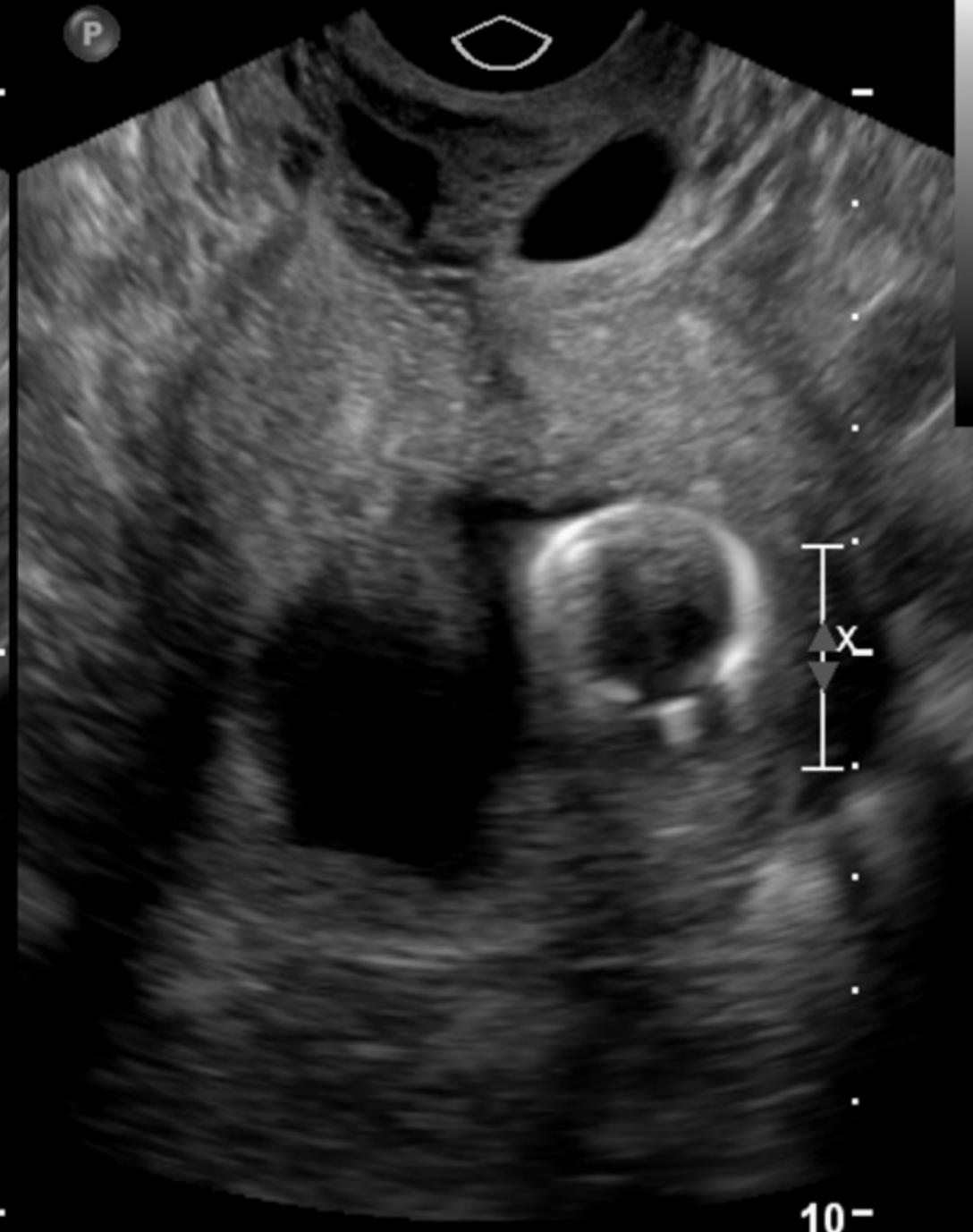
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SAG UTERUS

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What object is seen within the uterine cavity?

☒ Displaced vaginal pessary

☐ Contraceptive device

☐ Remnant surgical material

☐ Wedding ring

The question above accounts for 25% of your total score for this case.

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What object is seen within the uterine cavity?

- ☐ Displaced vaginal pessary
- ☒ Contraceptive device (correct!)
- ☐ Remnant surgical material
- ☐ Wedding ring

The question above accounts for 25% of your total score for this case.

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This contraceptive device is common in which of the following countries?

☐ South Korea

☐ India

☐ Brazil

☐ Nigeria

☐ China

The question above accounts for 25% of your total score for this case.

This contraceptive device is constructed of which of the following materials?

☐ Stainless steel

☐ Copper

☐ Aluminum

The question above accounts for 25% of your total score for this case.

This contraceptive device is common in which of the following countries?

☐ South Korea

☐ India

☐ Brazil

☐ Nigeria

☒ China (correct!)

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☒ Stainless steel (correct!)

☐ Copper

☐ Aluminum

The question above accounts for 25% of your total score for this case.

☐ Aluminum

The question above accounts for 25% of your total score for this case.

This contraceptive device is as effective as T-shaped hormonal and copper intrauterine devices commonly used in North America.

☐ True

☐ False

The question above accounts for 25% of your total score for this case.

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☐ Aluminum

The question above accounts for 25% of your total score for this case.

This contraceptive device is as effective as T-shaped hormonal and copper intrauterine devices commonly used in North America.

☐ True

☒ False (correct!)

The question above accounts for 25% of your total score for this case.

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Findings

- There is a ring-shaped hyperechoic foreign body with shadowing within the endometrial canal.
- There is a mildly thickened endometrium. The endometrial canal is expanded with mostly simple fluid, likely reflecting cervical stenosis.

Diagnosis (for foreign body): Stainless steel ring intrauterine contraceptive device

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Key points

Stainless steel ring intrauterine device

Background

- Intrauterine devices (IUDs) are the most popular contraceptive device in China with about 40% of woman of reproductive age using them. IUD use became especially widespread after China instituted the one-child policy in the late 1970s.
- The stainless steel ring (SSR) is the most widely used IUD in China, accounting for up to 90% of all IUDs.
- Given the large number of Chinese immigrants, the SSR IUD is an important device to recognize.

Construction

- It is constructed as a solid stainless steel ring. An SSR IUD is approximately one-quarter the cost of a copper IUD, accounting for its popularity in China.
- No string is attached, which makes it impossible to confirm its presence by a speculum physical exam.

Effectiveness

- It has a 12-month failure rate over 10%. compared with 1% to 2% for the T-shaped copper IUD

Effectiveness

- It has a 12-month failure rate over 10%. compared with 1% to 2% for the T-shaped copper IUD.
- It has a high expulsion rate of over 10%, compared with 1% to 2% for the T-shaped copper IUD. The high expulsion rate is particularly concerning since intrauterine presence cannot be determined by speculum physical exam due to the lack of a string.

Imaging

- Ultrasound: Appears as a uniformly hyperechoic circular ring with shadowing.
- Radiography/CT: Appears as a metallic intrauterine ring.

References

- Cheung VY. A 10-year experience in removing Chinese intrauterine devices. *Int J Gynaecol Obstet*. 2010;109(3):219-222.
- MacDonald TL, Gerscovich EO, McGahan JP, Fogata M. The Chinese ring: A contraceptive intrauterine device. *J Ultrasound Med*. 2006;25(2):273-275.

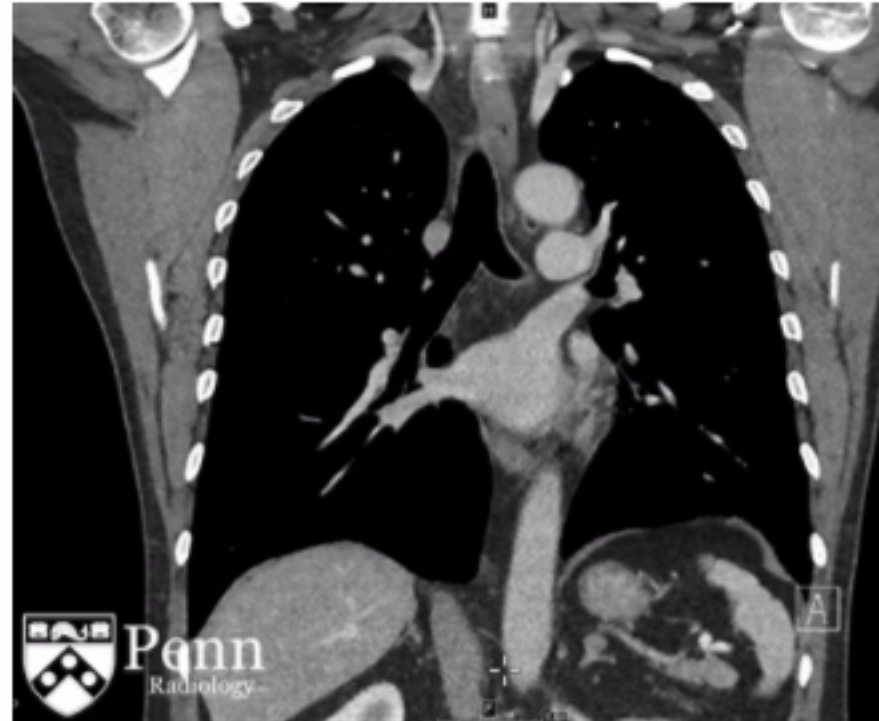
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History and CT images

Our appreciation is extended to Dr. Erica Alexander, University of Pennsylvania Department of Radiology, for contributing this case.

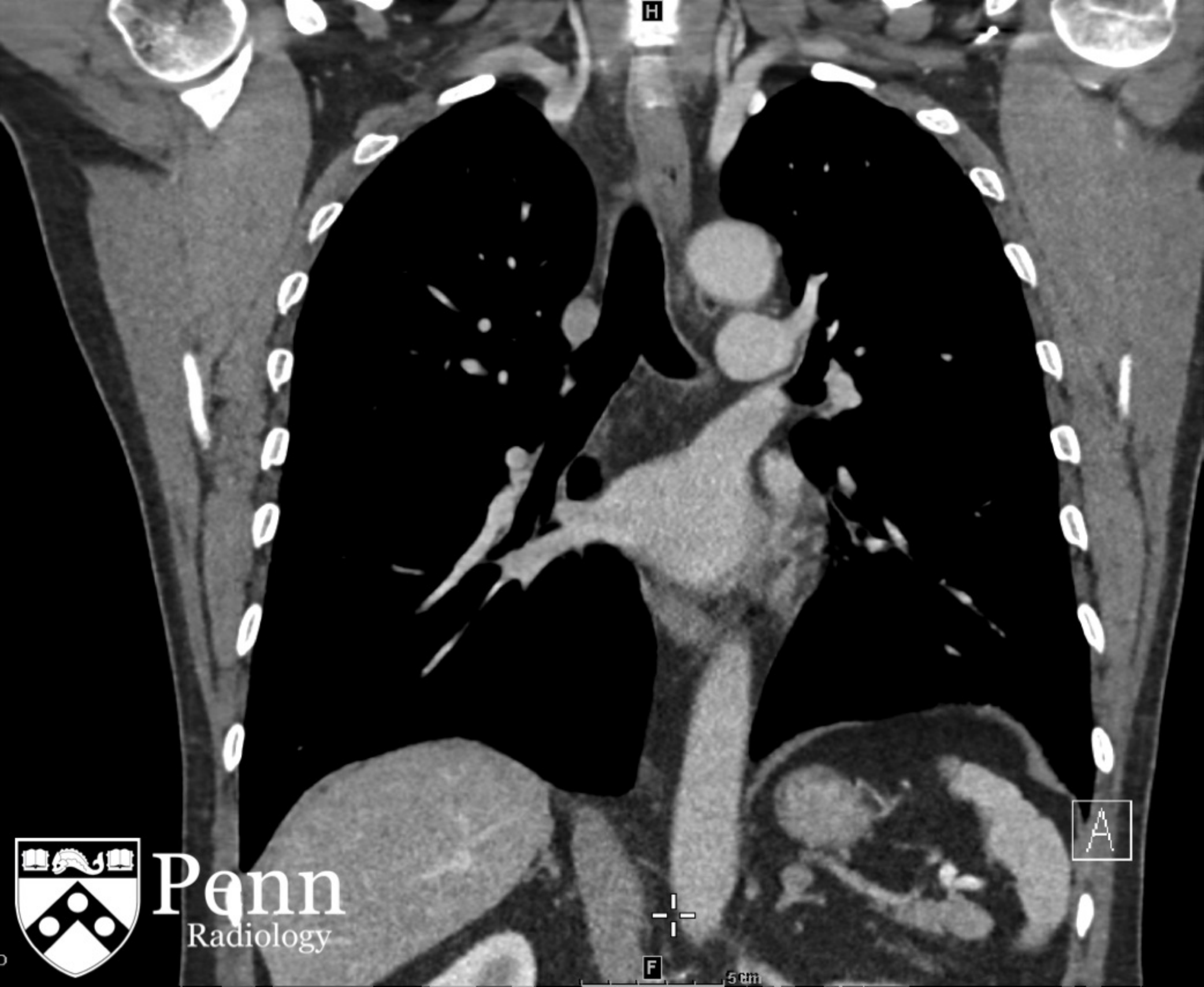
History: A 58-year-old occasional smoker was discovered to have pulmonary nodules and underwent a CT scan, which revealed an incidental finding in the abdomen.

Contrast-enhanced CT images of the chest and upper abdomen are shown below. Click to enlarge.





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F

5cm

In which organ is the abnormality located?

☐ Liver

☐ Gallbladder

☐ Pancreas

☐ Adrenal gland

The question above accounts for 20% of your total score for this case.

Which CT imaging feature would be most helpful to diagnose this lesion?

☐ Size

☐ Presence of enhancement

☐ Attenuation

The question above accounts for 15% of your total score for this case.

In which organ is the abnormality located?

☐ Liver

☐ Gallbladder

☐ Pancreas

☒ Adrenal gland (correct!)

The question above accounts for 20% of your total score for this case.

Which CT imaging feature would be most helpful to diagnose this lesion?

☐ Size

☐ Presence of enhancement

☒ Attenuation (correct!)

The question above accounts for 15% of your total score for this case.

Additional questions

If this lesion represents metastatic disease, then this patient would have stage IV disease.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

On the contrast-enhanced chest CT, the left adrenal nodule measures 71 Hounsfield units (HU). What is the next most appropriate step in workup for this nodule?

☐ Follow-up CT in three to six months

☐ PET/CT

☐ MRI

☐ Chemotherapy

Additional questions

If this lesion represents metastatic disease, then this patient would have stage IV disease.

☒ True (correct!)

☐ False

The question above accounts for 15% of your total score for this case.

On the contrast-enhanced chest CT, the left adrenal nodule measures 71 Hounsfield units (HU). What is the next most appropriate step in workup for this nodule?

☐ Follow-up CT in three to six months

☐ PET/CT

☒ MRI (correct!)

☐ Chemotherapy

Additional question

What sequence of MRI is diagnostic for this lesion?

- ☐ Diffusion-weighted imaging (DWI)
- ☐ Apparent diffusion coefficient (ADC)
- ☐ Contrast-enhanced T1-weighted imaging
- ☐ Chemical shift imaging

The question above accounts for 20% of your total score for this case.

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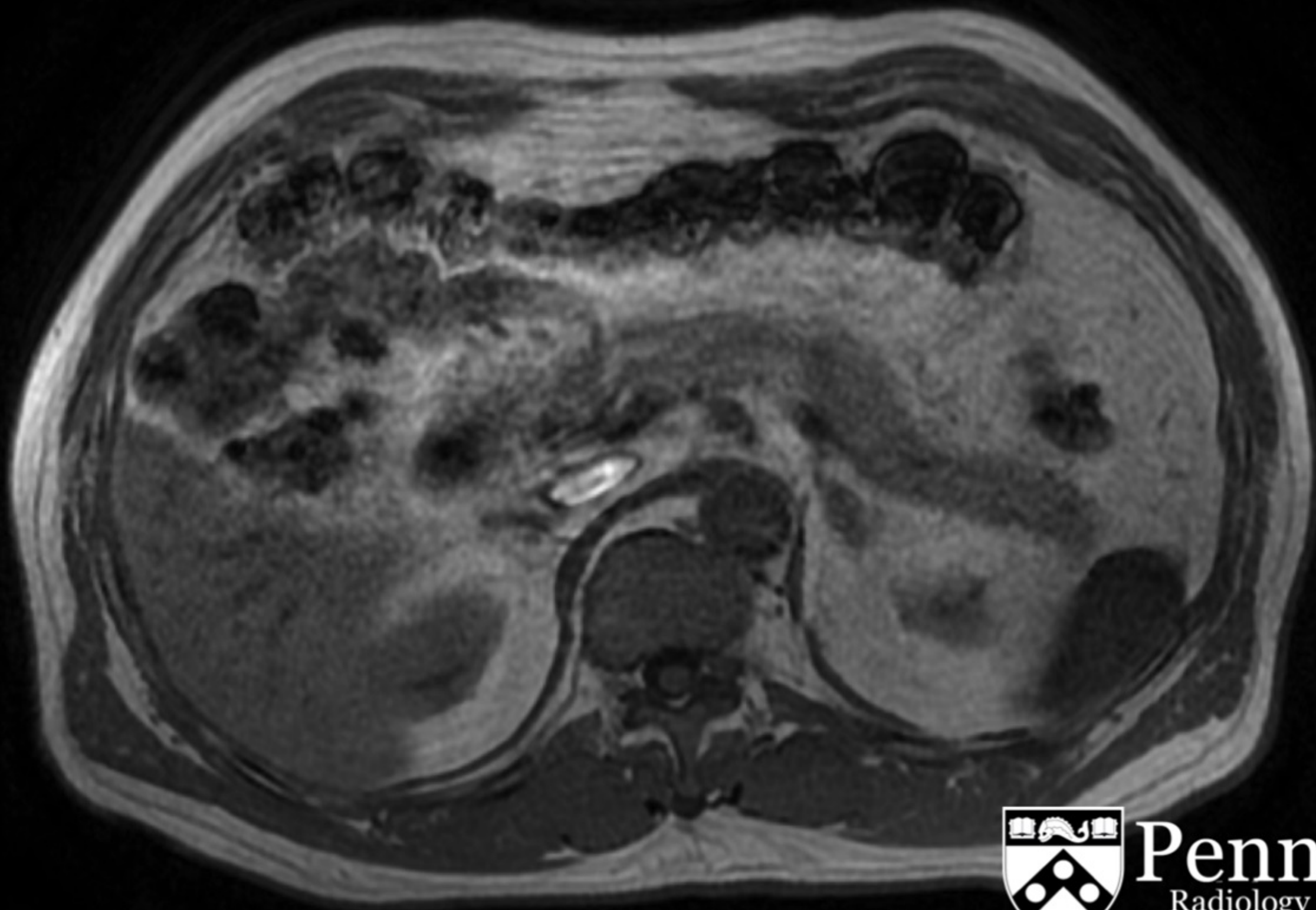
Additional question

What sequence of MRI is diagnostic for this lesion?

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- ☐ Apparent diffusion coefficient (ADC)
- ☐ Contrast-enhanced T1-weighted imaging
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The question above accounts for 20% of your total score for this case.

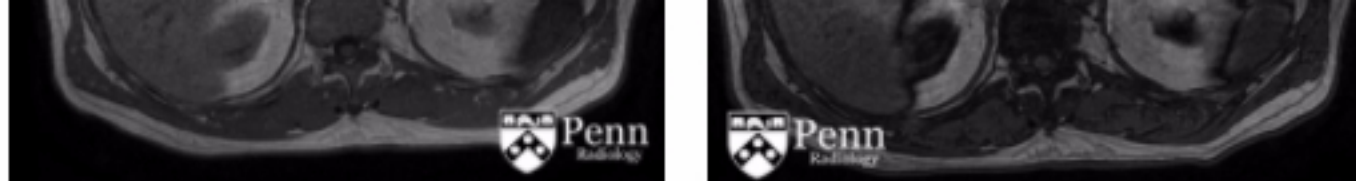
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The signal intensity of the adrenal lesion on in-phase images was 325, and the signal intensity on out-of-phase images was 93.

What is the diagnosis?

☐ Adrenal adenoma

☐ Adrenal hyperplasia

☐ Adrenal metastasis

☐ Pheochromocytoma

The question above accounts for 10% of your total score for this case.

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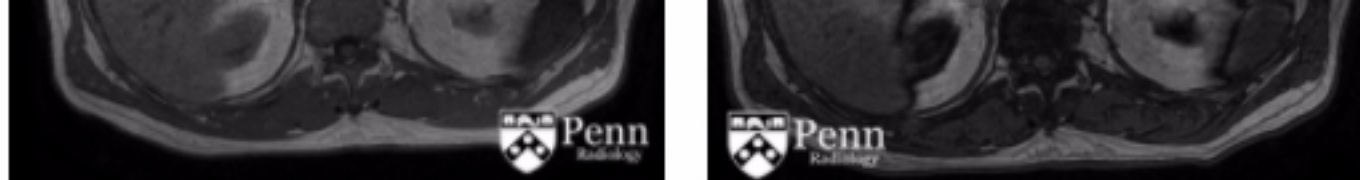
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The signal intensity of the adrenal lesion on in-phase images was 325, and the signal intensity on out-of-phase images was 93.

What is the diagnosis?

☒ Adrenal adenoma (correct!)

☐ Adrenal hyperplasia

☐ Adrenal metastasis

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The question above accounts for 10% of your total score for this case.

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Findings

- **CT:** There is a 13 x 11-mm left adrenal nodule. Its attenuation value measures 71 HU on postcontrast imaging. It is incompletely characterized and likely represents a simple adenoma.
- **MRI:** The right adrenal gland is normal. There is a left adrenal lesion that measures 14 x 8 mm and demonstrates marked signal dropout on out-of-phase imaging, which is diagnostic of an adrenal adenoma.

Differential diagnosis

- Adrenal adenoma
- Adrenal cortical carcinoma
- Adrenal metastasis
- Adrenal lymphoma
- Adrenal cyst
- Pheochromocytoma
- Focal adrenal hyperplasia
- Adrenal myelolipoma

Diagnosis: Adrenal adenoma

Discussion

Adrenal adenoma

Pathophysiology

Adrenal adenomas are common benign tumors arising from the cortex of the adrenal gland.

Epidemiology

Adrenal masses are common, seen in as many as 1% of CT exams. The incidence of adrenal adenomas increases with age.

Clinical presentation

The vast majority of adrenal adenomas are nonfunctioning and, therefore, asymptomatic. The small percent of adrenal adenomas that are hyperfunctioning present with excess hormone secretion.

Imaging features

Comparison to prior exams is helpful in diagnosing adrenal adenomas, as benign lesions tend to demonstrate long-term stability.

Typical features of adenomas include a size less than 3 cm, homogeneity, and low

Imaging features

Comparison to prior exams is helpful in diagnosing adrenal adenomas, as benign lesions tend to demonstrate long-term stability.

Typical features of adenomas include a size less than 3 cm, homogeneity, and low density. Atypical features include hemorrhage, calcification, necrosis, lack of fat, or larger size.

- CT: On CT, the density of the adrenal lesion is highly sensitive and specific in diagnosing an adrenal adenoma. Lipid-poor adenomas can be more difficult to diagnose via CT, as density will be closer to soft tissue. These can be evaluated by assessing the contrast washout rate. Adenomas should demonstrate rapid contrast washout at 15 minutes.
- MRI: The best way to evaluate adrenal adenomas is via chemical shift imaging. There should be signal dropout on opposed or out-of-phase imaging greater than 20%.

Treatment

Hyperfunctioning adrenal adenomas and nonfunctioning large lesions require resection. Small, nonfunctional adrenal lesions with typical features of an adenoma can be left in situ.

References

14-year-old boy with left-sided weakness, severe headaches

CASE OUTLINE

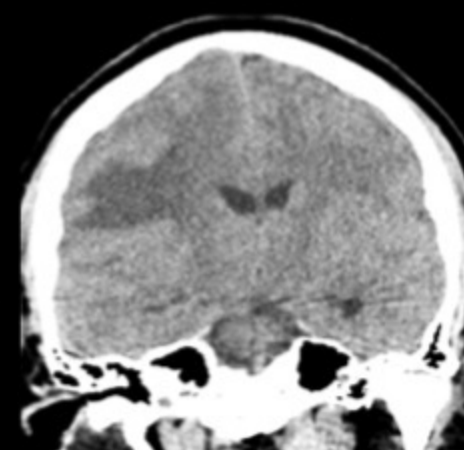
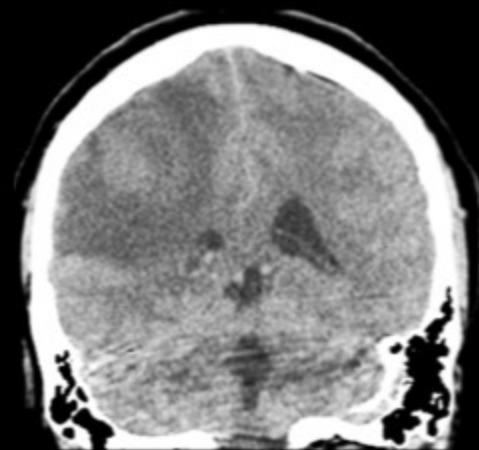
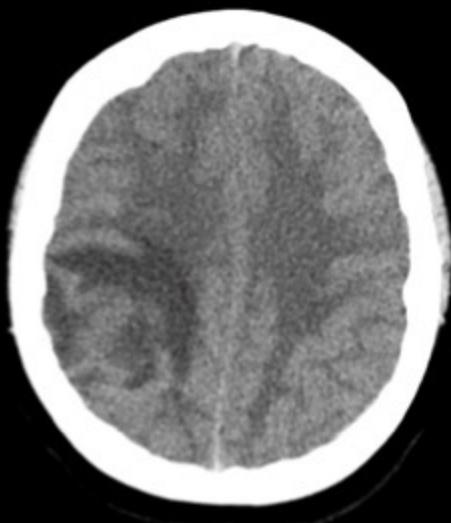
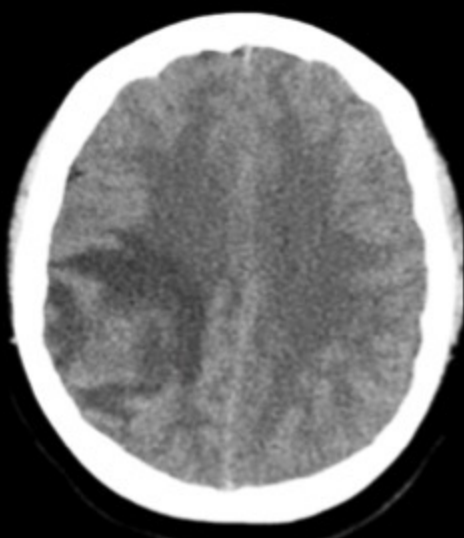
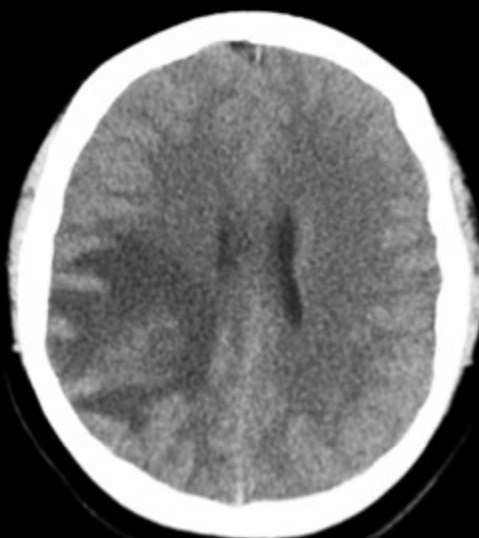
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History and CT images

Our appreciation is extended to Dr. Jeffrey Rudie, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 14-year-old boy with a history of recent sinusitis and preseptal cellulitis now presents with progressive left-sided weakness, headaches, nausea, and vomiting. A head CT scan performed at the time of the initial sinus infection was normal.

Another head CT scan was performed. Axial CT slices are shown in soft-tissue window below. Click to enlarge.



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What type of edema pattern is present?

☐ Vasogenic edema

☐ Cytotoxic edema

The question above accounts for 15% of your total score for this case.

The center of the abnormality is at the gray-white junction.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

What type of edema pattern is present?

☒ Vasogenic edema (correct!)

☐ Cytotoxic edema

The question above accounts for 15% of your total score for this case.

The center of the abnormality is at the gray-white junction.

☒ True (correct!)

☐ False

The question above accounts for 15% of your total score for this case.

The question above accounts for 15% of your total score for this case.

What is the next most appropriate step for a more definitive evaluation?

- ☐ Brain MRI without contrast
- ☐ Brain MRI brain with and without contrast
- ☐ CT angiography
- ☐ Head CT with contrast
- ☐ Cerebral angiography

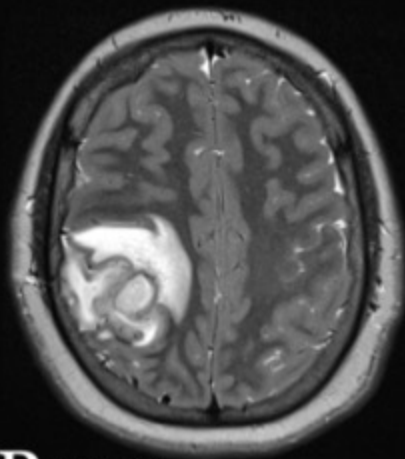
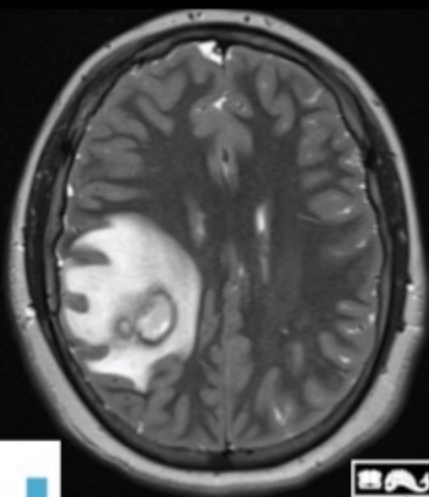
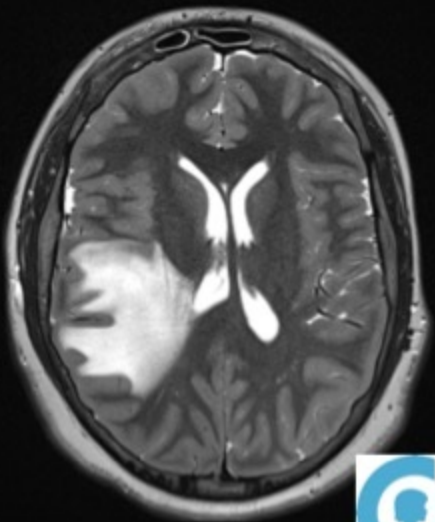
The question above accounts for 14% of your total score for this case.

The question above accounts for 15% of your total score for this case.

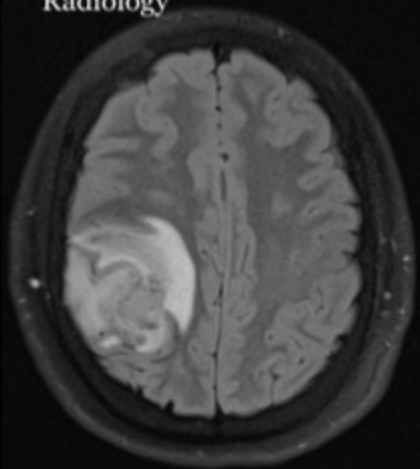
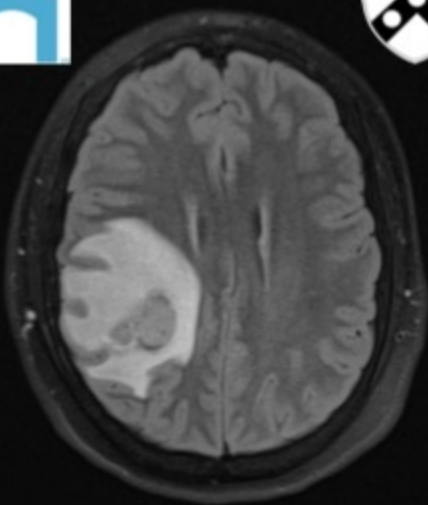
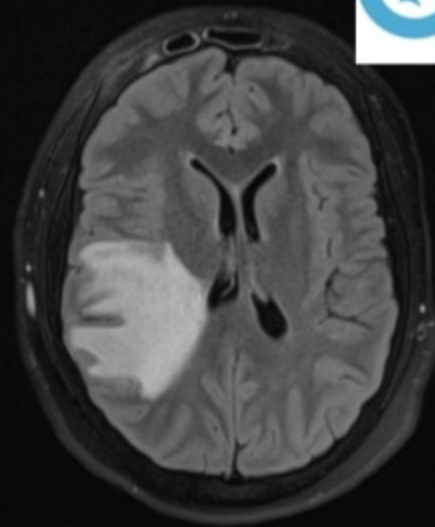
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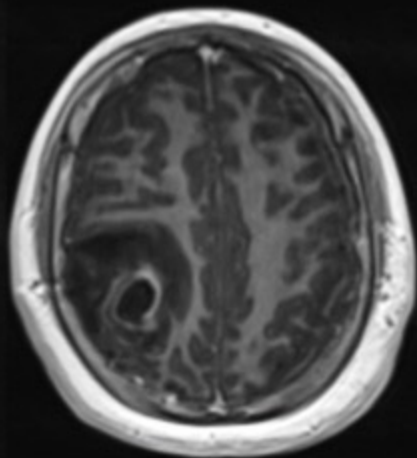
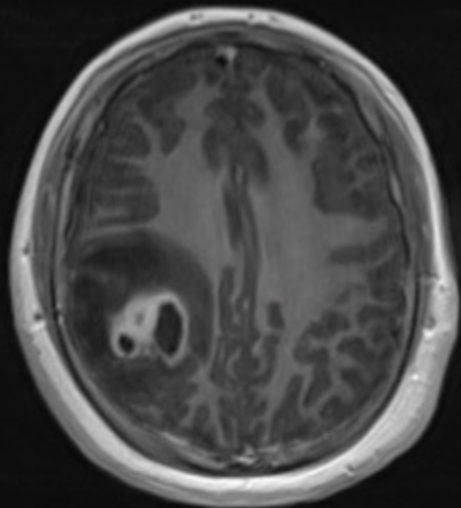
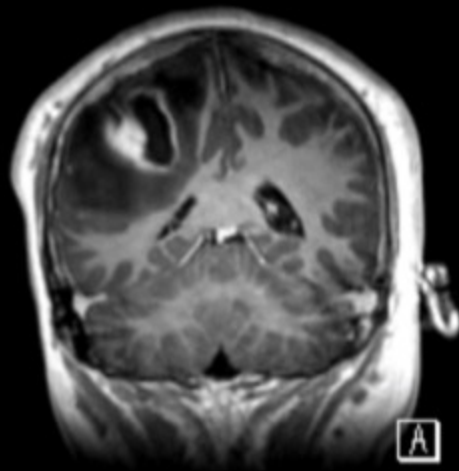
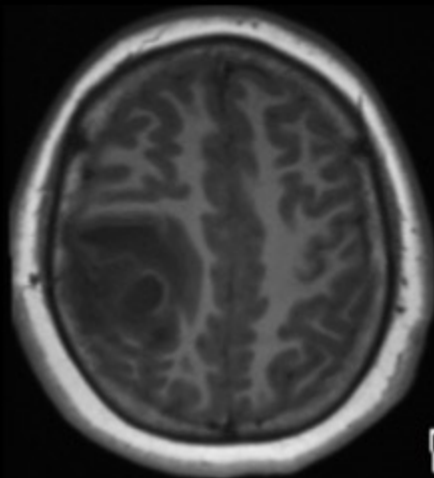
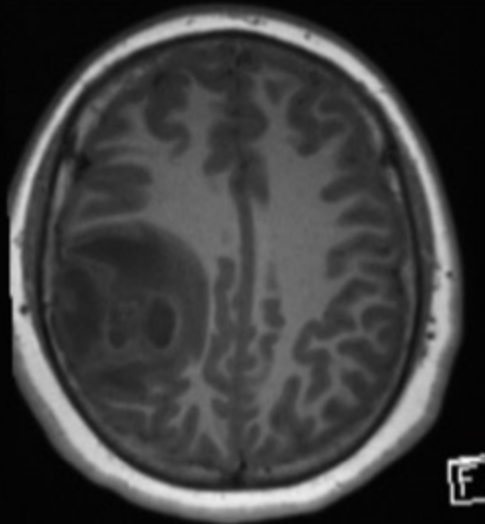
- ☐ Brain MRI without contrast
- ☒ Brain MRI brain with and without contrast (correct!)
- ☐ CT angiography
- ☐ Head CT with contrast
- ☐ Cerebral angiography

The question above accounts for 14% of your total score for this case.

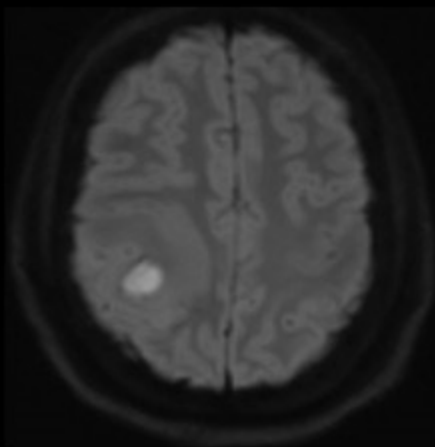
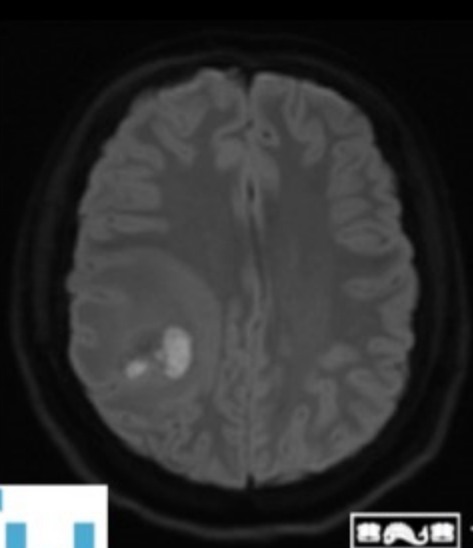
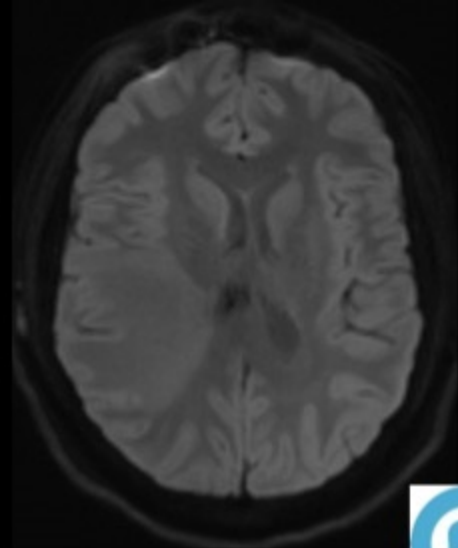


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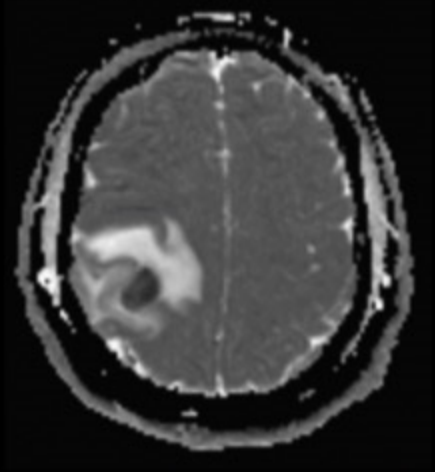
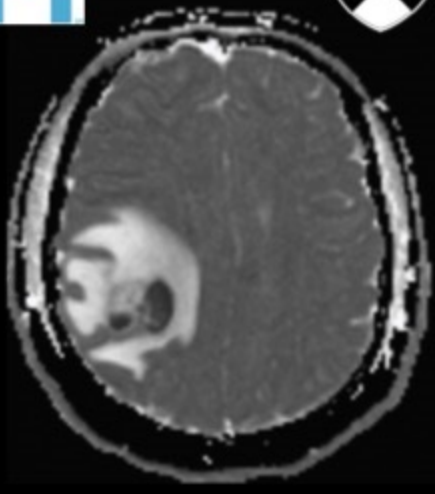
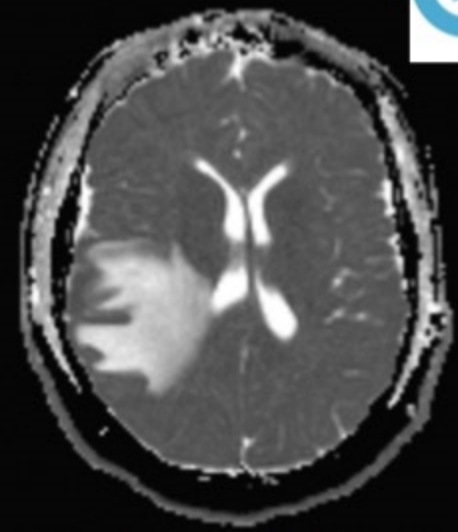




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There is restricted diffusion within the lesion.

☐ True

☐ False

The question above accounts for 14% of your total score for this case.

What is the predominant enhancement pattern?

☐ Cortical/gyriform

☐ Leptomeningial

☐ Rim enhancing

☐ Dural

☐ Extracranial

The question above accounts for 14% of your total score for this case.

There is restricted diffusion within the lesion.

☒ True (correct!)

☐ False

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☐ Dural

☐ Extracranial

The question above accounts for 14% of your total score for this case.

What is the most likely etiology of the lesions?

☐ Vascular hemorrhagic

☐ Autoimmune/vasculitis

☐ Infectious

☐ Neoplastic

☐ Genetic

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Glioblastoma

☐ Subacute infarction

☐ Septic emboli

☐ Cerebral abscess

☐ Tumefactive demyelination

☐ Focal cerebritis

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☒ Infectious (correct!)

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☐ Genetic

The question above accounts for 14% of your total score for this case.

What is the most likely diagnosis?

☐ Glioblastoma

☐ Subacute infarction

☐ Septic emboli

☒ Cerebral abscess (correct!)

☐ Tumefactive demyelination

☐ Focal cerebritis

Findings

- **Head CT:** Centered in the right centrum semiovale is a large area of vasogenic edema extending into the frontal, temporal, and parietal lobes. There is mild effacement of the right lateral ventricle and mild bowing of the midline to the left.
- **Brain MRI:** There is a 2.4 x 2.8 x 3.3-cm (AP x TR x CC) heterogeneous rim-enhancing multilocular subcortical mass with peripheral T2 hyperintensity in the right frontoparietal region extending to the centrum semiovale and corona radiata. There is marked associated vasogenic edema associated with local sulcal effacement, partial right lateral and third ventricular effacement, and mild leftward midline shift of approximately 4 mm. The central portion of the mass demonstrates centrally restricted diffusion.

Differential diagnosis

- Cerebral abscess
- High-grade glioma
- Focal cerebritis
- Tumefactive demyelination
- Subacute infarction
- Radiation necrosis
- Septic emboli

Diagnosis: Cerebral abscess

Discussion

Intracranial cerebral abscess

Epidemiology and pathogenesis

Cerebral abscesses are focal suppurative intracranial infections that start as an area of focal cerebritis, eventually demarcating into discrete collections of encapsulated pus surrounded by a well-vascularized capsule. They progress through four classic stages: early cerebritis, late cerebritis, early capsular, and late capsular. In the later stage, there is a rim of granulation tissue surrounded by increasing angiogenic neovascularity, which causes increasing cerebral edema.

The most common etiology is direct extension from the sinuses, eyes, and dental infections, followed by hematogenous seeding (more often multifocal due to endocarditis or chronic pulmonary infections) or rarely direct trauma (sometimes iatrogenic). Up to 25% to 35% of cases in children may have an unknown, cryptic source. Increased risk is associated with immunosuppression, congenital heart conditions, including patent foramen ovale and arteriovenous fistulas. Numerous different pathogens are associated, most commonly mixed species, including *Streptococcus pneumoniae*, *Staphylococcus aureus* and *S. epidermidis*, *Actinomyces*, HACEK bacteria, gram-negative species in infants, and group B streptococcus in neonates. In immunocompromised patients, additional pathogens include toxoplasmosis, *Nocardia*, *Candida*, *Listeria*, *Mycobacterium*, and *Aspergillus*. The incidence is estimated at 0.3 to 0.9 per 100,000 with a 2-3:1 preponderance in males compared with females.

Clinical presentation

Clinical presentation

The classic triad, including headache (approximately 69%), fever (53%), and focal neurologic deficit (48%), is seen in only approximately 20% of cases, with symptoms occurring about eight days prior to diagnosis. Other neurological deficits include seizures (25%) and altered mental status (48%). The abrupt onset of meningeal signs with worsening headache and neurological status is associated with rupture of an abscess into the ventricular space causing ventriculitis, which is associated with high mortality.

Imaging features

- Approximately 80% of brain abscesses are solitary, and they are most commonly seen in the frontal and temporal lobes.
- Early cerebritis is often invisible on CT but may demonstrate an area of poorly marginated subcortical hypodensity.
- Late cerebritis and early capsular stages will demonstrate irregular rim enhancement on contrast-enhanced CT and MRI.
- Contrast-enhanced CT and MRI in the late capsular stage will show a capsular ring that is T1 hyperintense and T1 hypointense, with a complete ring of enhancement with a central area of necrosis.
- In later stages, there will also be a large amount of surrounding vasogenic edema due to vascular permeability (seen as white-matter hypoattenuation on CT and high T2/FLAIR signal on MRI).

commonly seen in the frontal and temporal lobes.

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- Contrast-enhanced CT and MRI in the late capsular stage will show a capsular ring that is T1 hyperintense and T1 hypointense, with a complete ring of enhancement with a central area of necrosis.
- In later stages, there will also be a large amount of surrounding vasogenic edema due to vascular permeability (seen as white-matter hypoattenuation on CT and high T2/FLAIR signal on MRI).
- On MRI, the central necrotic area is hypointense on T1 and hyperintense on T1 with restricted diffusion.
- Susceptibility-weighted imaging (SWI) may show a low-intensity rim of increased susceptibility that mostly overlaps with the contrast-enhancing rim, sometimes with a double rim sign (two concentric rims inside and outside abscess cavity), distinguishing it from glioblastoma.
- In some cases, MRI spectroscopy and MR perfusion can be helpful for distinguishing an abscess from a high-grade glioma with a necrotic core. Relative cerebral blood volume (rCBV) is elevated in high-grade gliomas and reduced in abscesses, while elevated succinate peak is specific for an abscess.

Treatment and prognosis

Relative cerebral blood volume (rCBV) is elevated in high-grade gliomas and reduced in abscesses, while elevated succinate peak is specific for an abscess.

Treatment and prognosis

- Intracranial abscesses progress rapidly and lead to devastating and permanent neurological deficits.
- The mainstay treatment is with neurosurgical intervention to drain the collection, either by aspiration or craniotomy.
- This is combined with IV antibiotics, which is first broad and then tailored to the specific organisms involved.
- Given the high risk of seizures, seizure prophylaxis is recommended in all patients.
- In cases of abscesses secondary to septic emboli from cardiac infections, heart valve surgery may be necessary to treat persistent vegetations.

References

1. Bonfield CM, Sharma J, Dobson S. Pediatric intracranial abscesses. *J Infection*. 2015;71(suppl 1):S42-S46.
2. Shih RY, Koeller KK. Bacterial, fungal and parasitic infections of the central nervous system: Radiologic-pathologic correlation and historical perspectives. *Radiographics*. 2015;35(4):1141-1169.
3. Smirniotopoulos JG, Murphy FM, Rushing EJ, Rees JH, Schroeder JW. Patterns of contrast enhancement in the brain and meninges. *Radiographics*

40-year-old man with epigastric pain

CASE OUTLINE

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History and ultrasound images

Our appreciation is extended to Dr. Erica Alexander, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 40-year-old man presents to his primary care physician with recurrent episodes of bloating and reflux, with periodic epigastric pain. An abdominal ultrasound scan was ordered.

Images from a limited ultrasound scan of the abdomen are shown below. Click to enlarge.

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C 55
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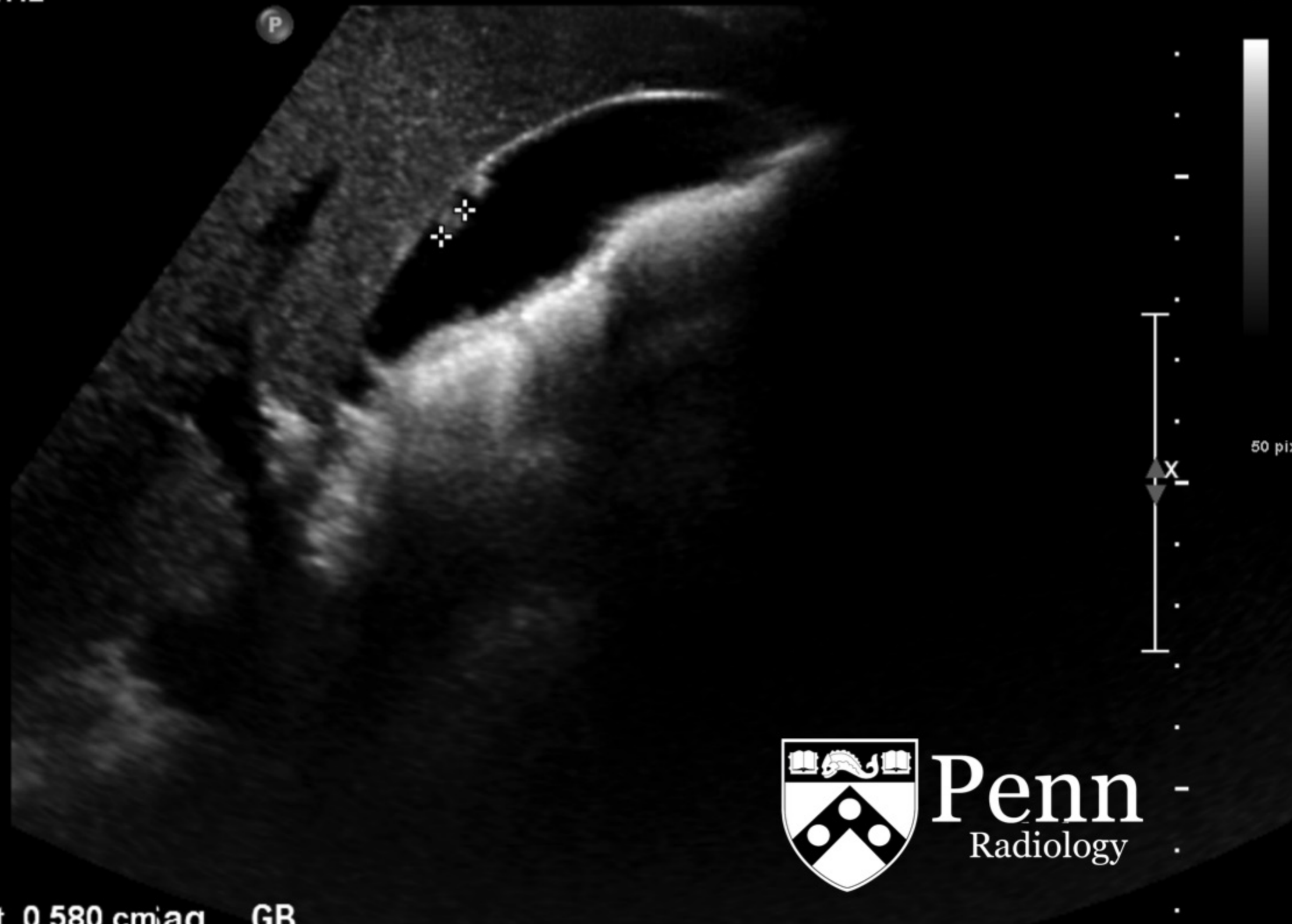
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CF

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+18.5



-18.5
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Sag GB

There is intrahepatic bile duct dilatation.

☐ True

☐ False

The question above accounts for 15% of your total score for this case.

There is evidence of acute cholecystitis.

☐ True

☐ False

There is intrahepatic bile duct dilatation.

☐ True

☒ False (correct!)

The question above accounts for 15% of your total score for this case.

There is evidence of acute cholecystitis.

☐ True

☒ False (correct!)

The question above accounts for 15% of your total score for this case.

What finding is seen within the gallbladder?

- ☐ Gallstones
- ☐ Gallbladder polyp
- ☐ Tumefactive sludge
- ☐ Adenomyomatosis

The question above accounts for 20% of your total score for this case.

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The question above accounts for 15% of your total score for this case.

What finding is seen within the gallbladder?

- ☐ Gallstones
- ☒ Gallbladder polyp (correct!)
- ☐ Tumefactive sludge
- ☐ Adenomyomatosis

The question above accounts for 20% of your total score for this case.

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Additional questions

Gallbladder polyps demonstrate acoustic shadowing on ultrasound.

☐ True

☐ False

The question above accounts for 17% of your total score for this case.

What is the commonly accepted size criterion for which gallbladder polyps do not need further follow-up?

☐ 4 mm or smaller

☐ 6 mm or smaller

☐ 8 mm or smaller

☐ 10 mm or smaller

The question above accounts for 17% of your total score for this case.

Additional questions

Gallbladder polyps demonstrate acoustic shadowing on ultrasound.

☐ True

☒ False (correct!)

The question above accounts for 17% of your total score for this case.

What is the commonly accepted size criterion for which gallbladder polyps do not need further follow-up?

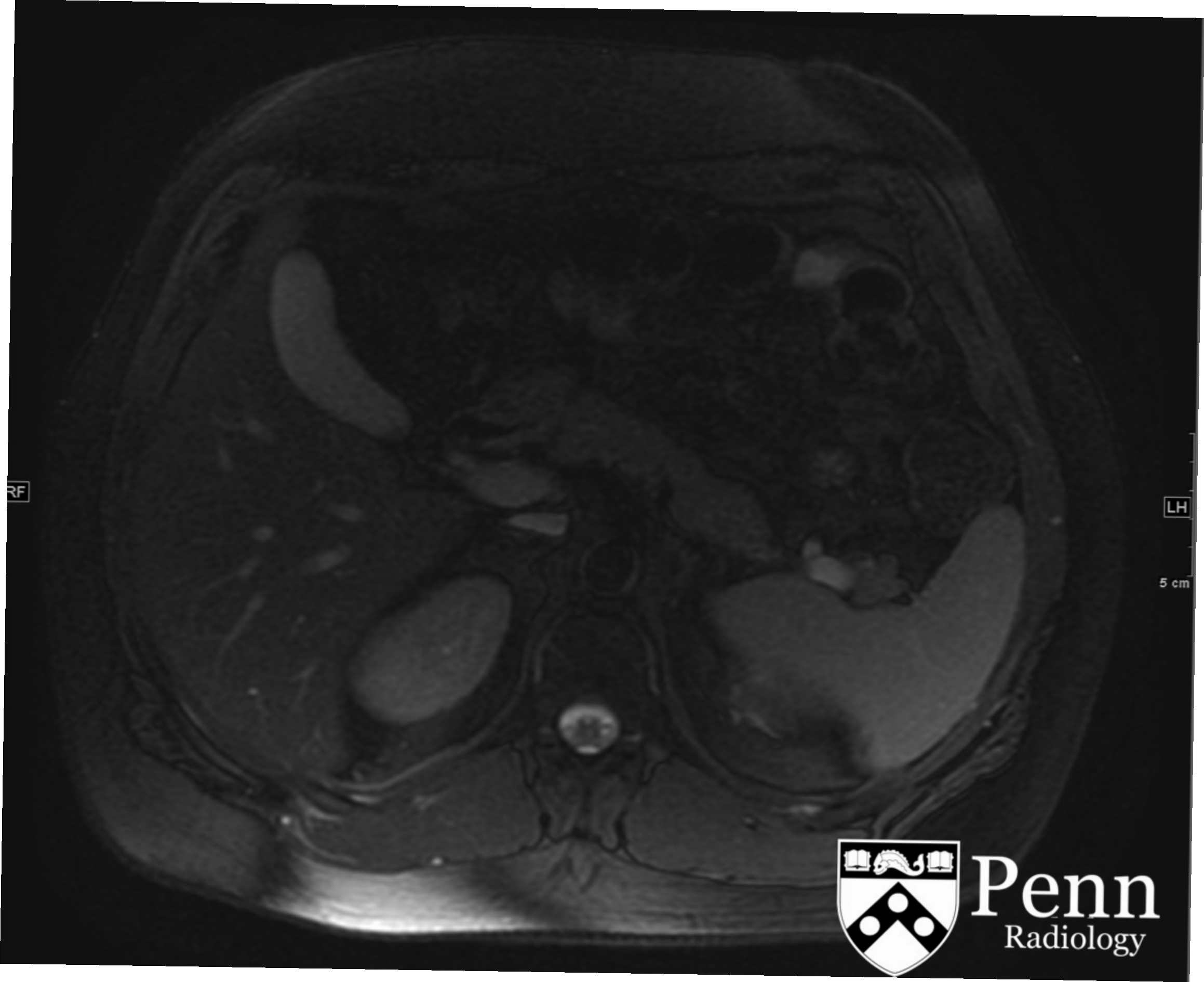
☐ 4 mm or smaller

☒ 6 mm or smaller (correct!)

☐ 8 mm or smaller

☐ 10 mm or smaller

The question above accounts for 17% of your total score for this case.



RF

LH

5 cm



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m: 2

HR

RAF

LPH

5 cm

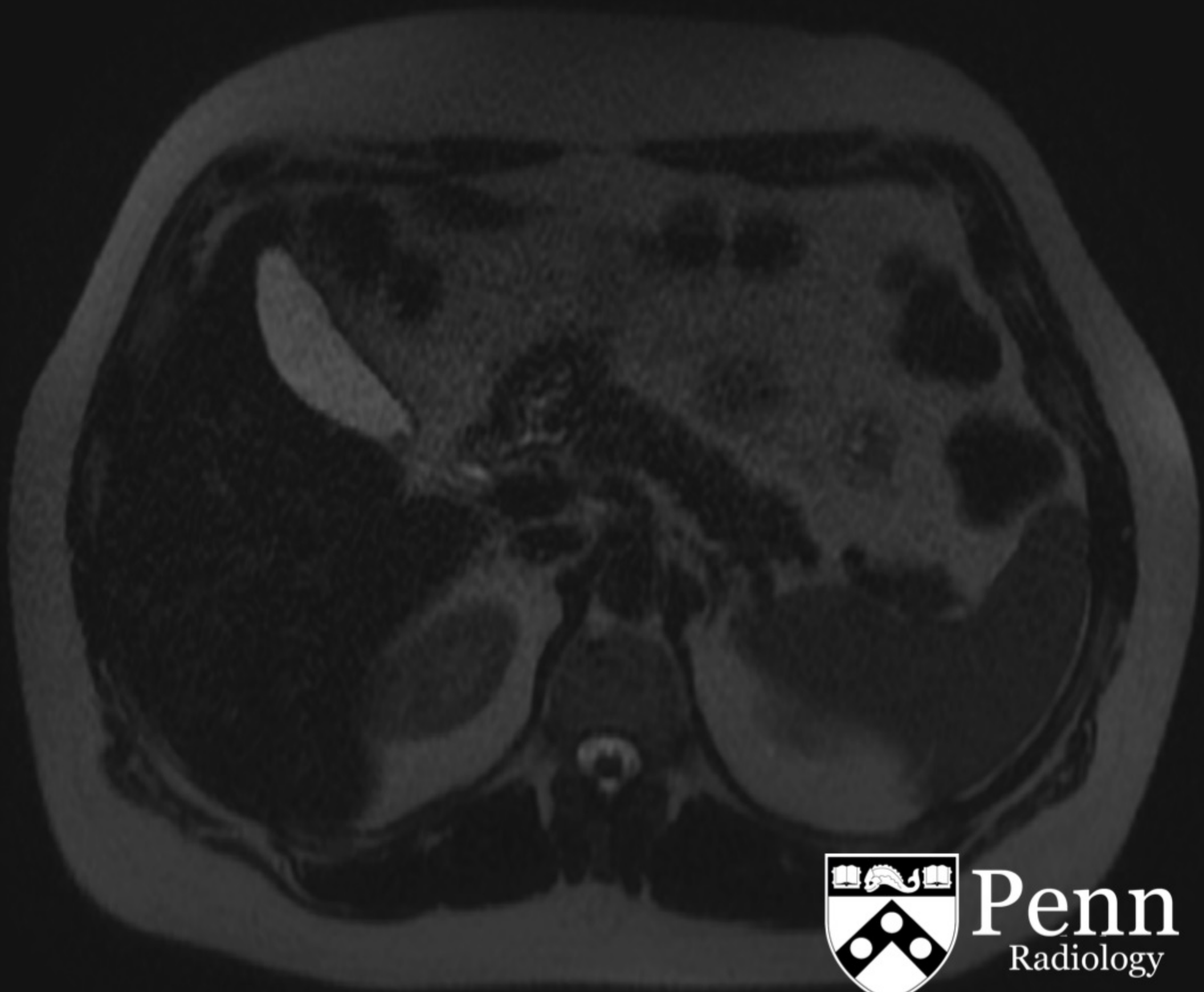
FL

5 cm



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Radiology

W: 1700
L: 850



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Radiology

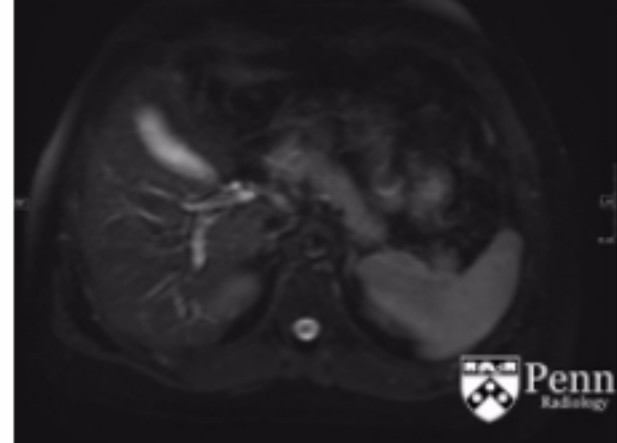
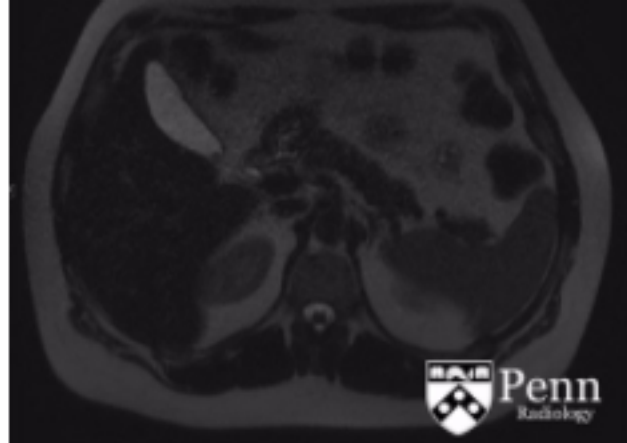
RF

LH

5 cm



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What is the role of MRI in evaluating gallbladder polyps smaller than 6 mm?

- ☐ Differentiate adenomatous from cholesterol polyps
- ☐ Differentiate benign from malignant lesions
- ☐ No established role

The question above accounts for 16% of your total score for this case.

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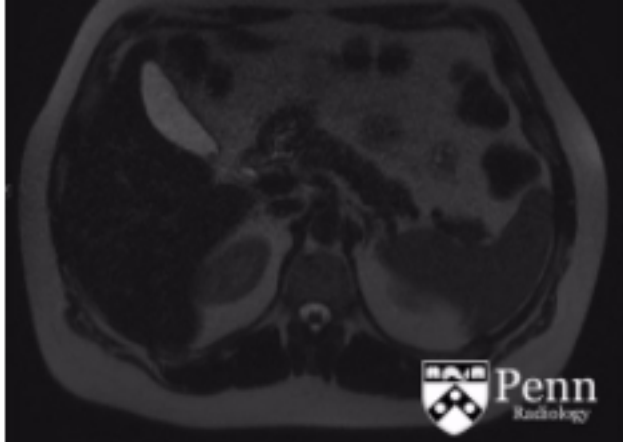
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What is the role of MRI in evaluating gallbladder polyps smaller than 6 mm?

- ☐ Differentiate adenomatous from cholesterol polyps
- ☐ Differentiate benign from malignant lesions
- ☒ No established role (correct!)

The question above accounts for 16% of your total score for this case.

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Findings

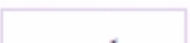
- **Ultrasound:** The echogenicity of the liver is mildly increased. No intra- or extrahepatic biliary dilatation is visualized; the common bile duct measures 0.4 cm. Arising from both the anterior and posterior walls of the gallbladder are multiple small echogenic nonmobile nodules. The largest of these measures up to 0.6 cm. There are no gallstones or sludge.
- **MRI:** The gallbladder polyps were better appreciated on ultrasound imaging. The imaging of gallbladder polyps on MRI is nonspecific, with polyps having intermediate signal intensity on T1- and T2-weighted imaging.

Differential diagnosis

- Gallstones
- Gallbladder polyps
- Tumefactive sludge
- Adenomyomatosis
- Polypoid gallbladder carcinoma

Diagnosis: Gallbladder polyps

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Discussion

Gallbladder polyps

Pathophysiology

Gallbladder polyps are outgrowths of the gallbladder mucosal wall and involve a spectrum of lesions with similar morphology and appearance. Most polyps are benign cholesterol polyps or benign adenomas.

Cholesterol polyps account for 50% of gallbladder polyps and generally measure less than 10 mm. Cholesterol polyps have no malignant potential. Large retrospective studies have shown that polyps 6 mm or smaller are not neoplastic.

Epidemiology

The incidence of gallbladder polypoid lesions has been reported between 3% to 5% in the adult population. There is no relationship between gallbladder polyps and age, gender, or obesity.

Clinical presentation

Most gallbladder polyps are asymptomatic. There is some discussion that polyps may be associated with chronic dyspepsia. Cholesterol polyps have the potential to detach and behave like stones, causing biliary colic, obstruction, or pancreatitis.

Imaging features

Size is the most important indicator of malignancy with gallbladder polyps; lesions greater than 10 mm have a malignancy rate between 37% and 88%.

- **Ultrasound:** Ultrasound is the best modality to evaluate gallbladder polyps and can be used to differentiate cholesterol polyps from those that require treatment. On ultrasound, gallbladder polyps demonstrate nonshadowing polypoid ingrowth into the gallbladder lumen. The polyps tend to be immobile. Small cholesterol polyps can be echogenic but nonshadowing, while larger cholesterol polyps tend to be hypoechoic. Adenomas tend to be larger and solitary; they demonstrate internal vascularity and intermediate echogenicity. It is not possible to distinguish adenomas from adenocarcinoma via ultrasound.
- **CT:** CT is suboptimal at detecting smaller polyps. Larger polyps appear as soft-tissue attenuation that projects into the gallbladder polyps. Enhancement that is greater than the remaining gallbladder wall should be viewed with suspicion.
- **MRI:** The imaging of gallbladder polyps on MRI is nonspecific, with polyps having intermediate signal intensity on T1- and T2-weighted imaging. Malignant polypoid lesions tend to have increased signal on diffusion images compared to benign polyps.

Treatment

Gallbladder polyps are relatively common, and their malignant potential is low. Lesions 6 mm or smaller do not require follow-up. Lesions between 6 mm and 9 mm should be followed up at three- to six-month intervals for one year to ensure stability. Lesions 10 mm or larger warrant surgical consideration.

References





*DEH
LT

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Which choice best characterizes the salient findings?

- ☐ Multiple intestinal objects compatible with contraband
- ☐ Foreign body in rectum compatible with contraband
- ☐ Foreign body in stomach compatible with contraband
- ☐ Diffuse ileus compatible with recent illicit drug use
- ☐ Unremarkable images

The question above accounts for 50% of your total score for this case.

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Which choice best characterizes the salient findings?

- ☐ Multiple intestinal objects compatible with contraband
- ☐ Foreign body in rectum compatible with contraband
- ☐ Foreign body in stomach compatible with contraband
- ☐ Diffuse ileus compatible with recent illicit drug use
- ☒ Unremarkable images (correct!)

[Explain this Answer]

The question above accounts for 50% of your total score for this case.

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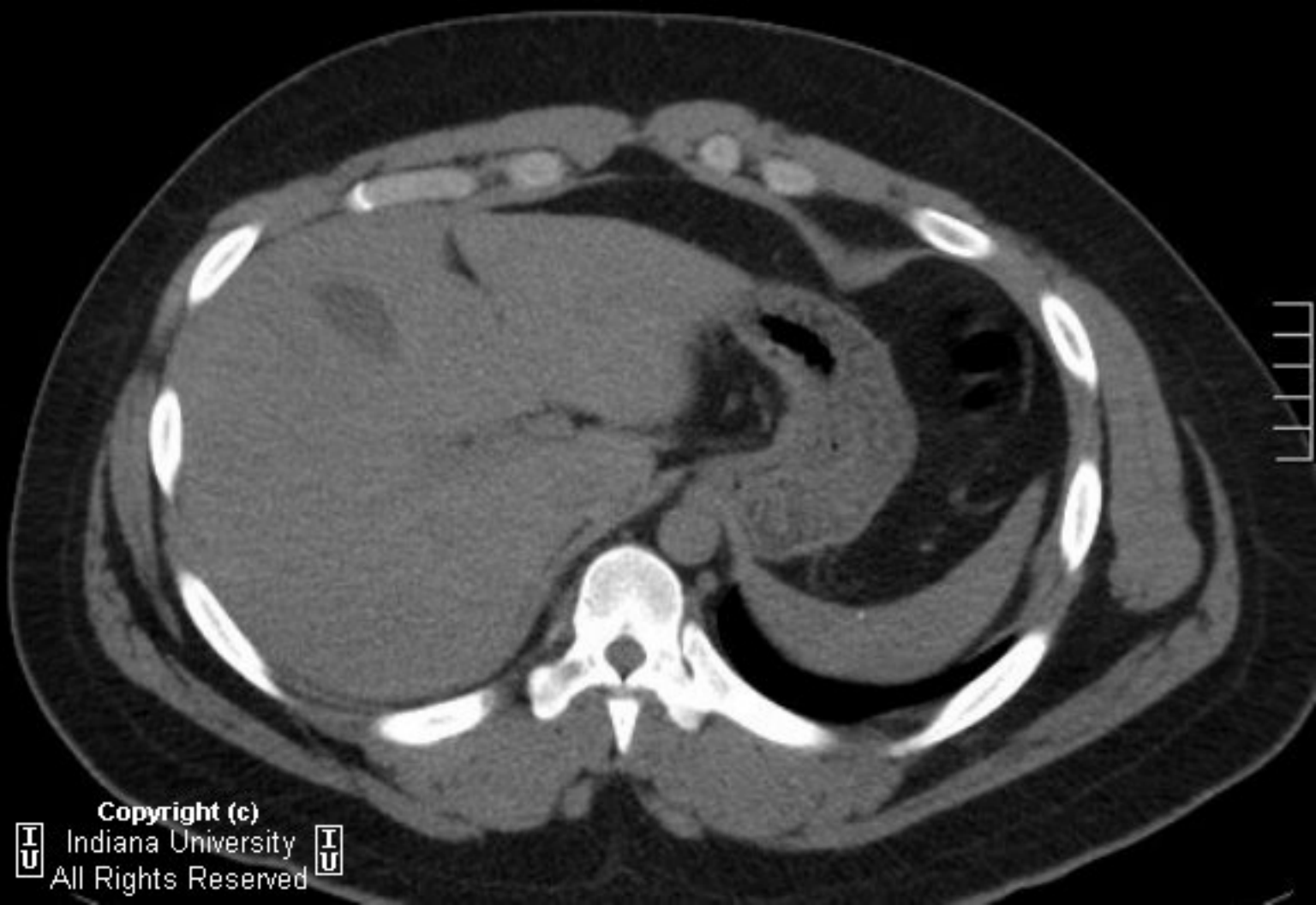
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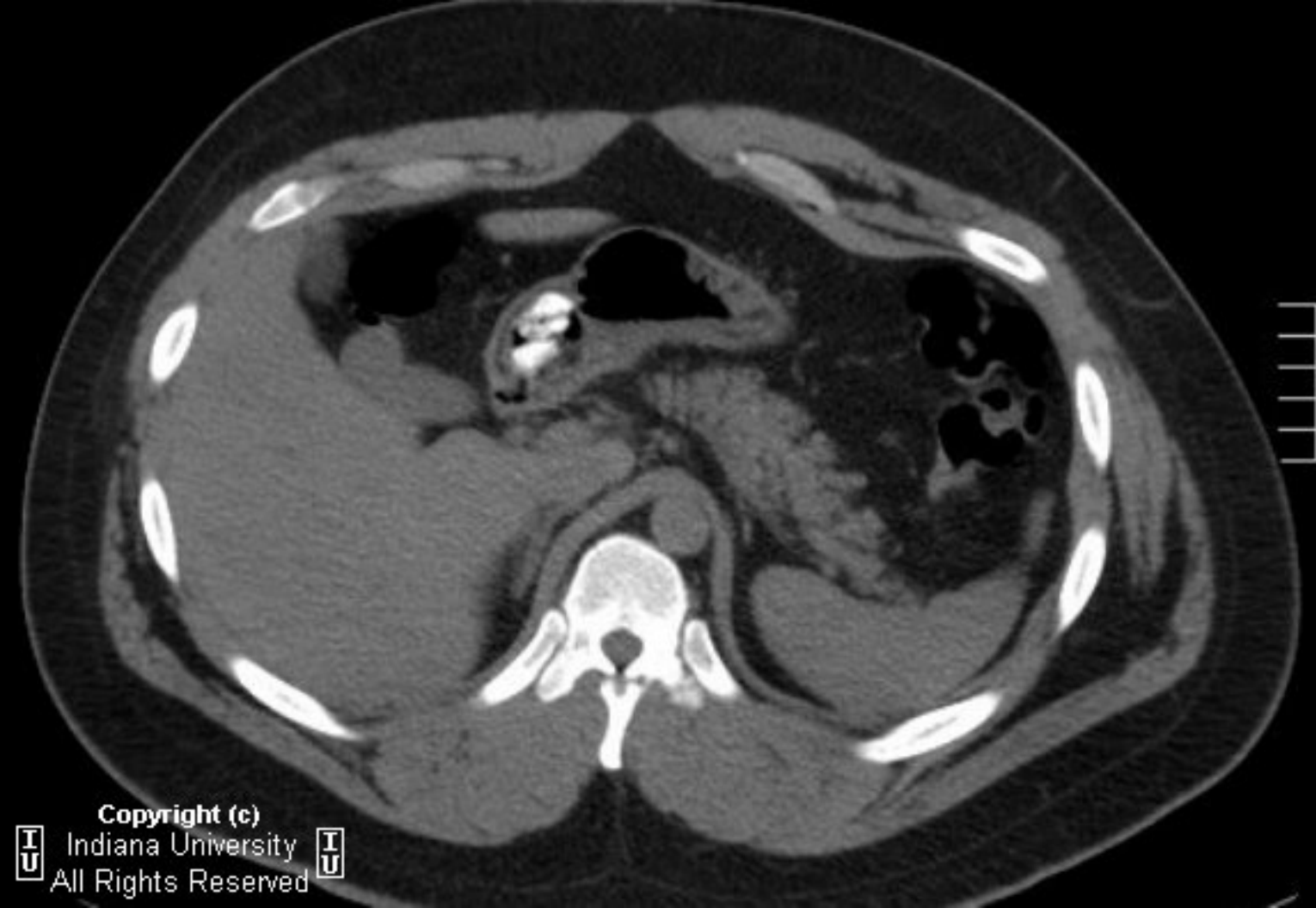
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SAL

IPR



SAL

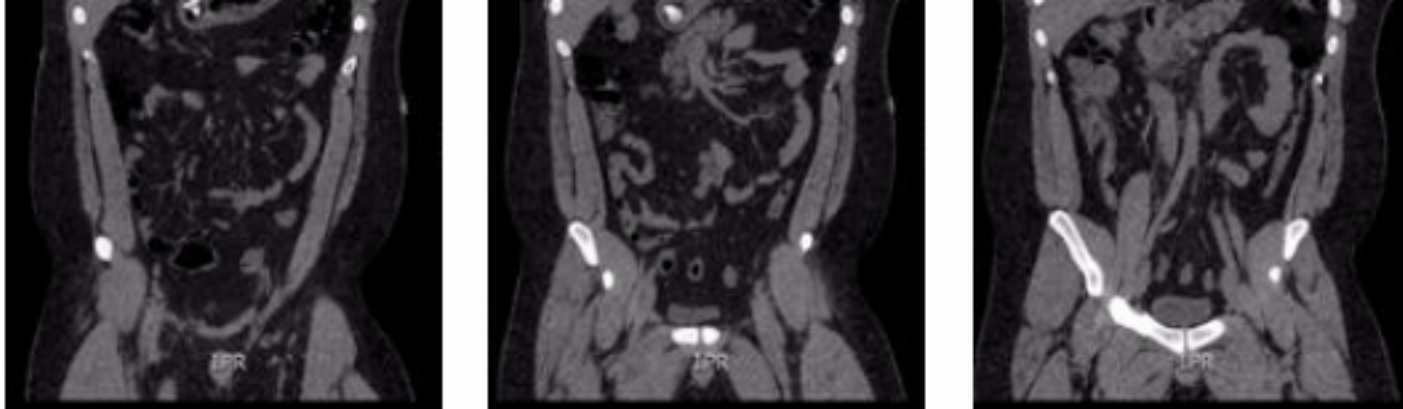
IPR



SAL

IPR





Where is the booty?

☐ Colon

☐ Rectum

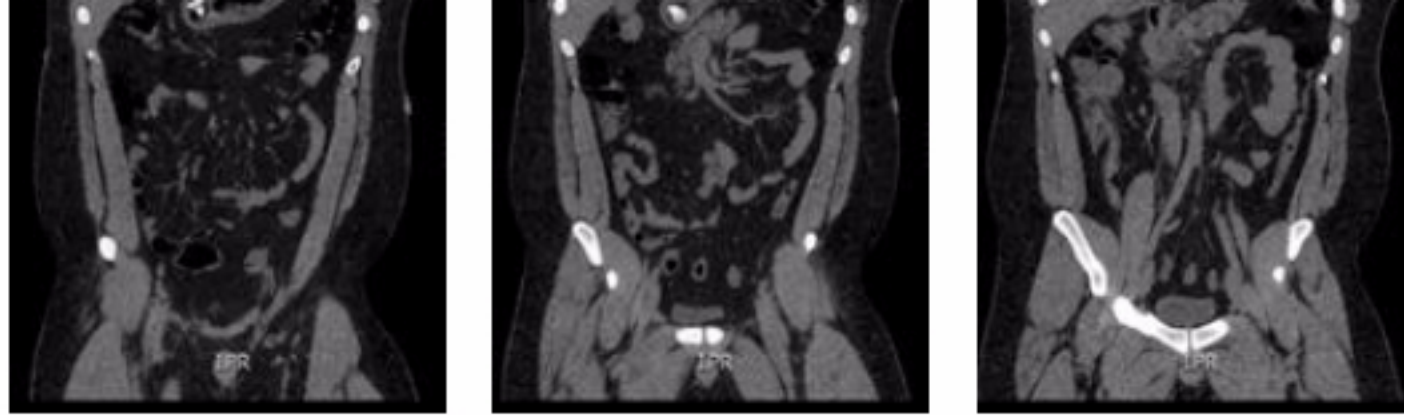
☐ Small bowel

☐ Stomach

☐ All of the above

The question above accounts for 50% of your total score for this case.

[VIEW YOUR SCORE](#)



Where is the booty?

☐ Colon

☐ Rectum

☐ Small bowel

☒ Stomach (correct!)

☐ All of the above

[Explain this Answer]

The question above accounts for 50% of your total score for this case.

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Findings

- **Abdominal radiographs:** No radiodense foreign bodies or other abnormalities are seen.
- **Abdominal CT:** A foreign body, measuring 2.9 x 1.5 x 1.1 cm, is seen within the stomach near the pylorus, consistent with cocaine-filled bag.

Differential diagnosis

- Ingested foreign body
- Focal collection of retained enteric contrast or barium
- Mineral density food/medicine bolus
- Cocaine pack

Diagnosis: Ingested foreign body (cocaine pack, “body stuffer”)

Case follow-up: Consecutive abdominal CT scans demonstrated persistent intragastric location of this radiodense foreign body without passage despite several laxatives, totaling six days. On the sixth day, the patient began to demonstrate signs of toxicity, including tachycardia and new positive urine drug screen for cocaine (negative on admission). At that time, the foreign bodies (two packets of cocaine) were removed by endoscopy and surrendered to law enforcement officials.

Key points

Body stuffers and packers

Historical points

- Cocaine was first known to the medical profession as an anesthetic. Dr. William Stewart Halsted used it to perform the first nerve block in 1884 and subsequently became the first recorded cocaine-impaired physician.
- After cocaine's addictive characteristics were realized, the Harrison Narcotics Tax Act of 1914 regulated and taxed the production, importation, and distribution of opiates and coca products.

Body stuffing and packing logistics

- Body stuffers are those who ingest drug packages quickly to avoid arrest. Risks of body stuffing include aspiration during ingestion and pack rupture/leakage, resulting in cocaine toxicity or death after ingestion.
- Body packers are those individuals who swallow numerous carefully concealed packs of cocaine, or "bolitas," in an attempt to smuggle drugs.
 - A single pack is usually sausage-shaped (5 x 2 cm) or round (2 cm) and contains approximately 8-10 grams of pure cocaine. This can be diluted to create 30 g of street product, totaling monetary worth of about \$1000 (per pack). One body packer can carry anywhere from 40 to 80 packs, totaling \$40,000 to \$80,000. Packs must be swallowed at timed intervals to fill the gastrointestinal tract, and use of parasympathomimetic drugs to inhibit or delay defecation for long-term smuggling is common.
 - Bolitas may also be inserted into body cavities, such as the rectum and vagina.

Imaging findings

- Plain radiographs: Radiographs have a false negative rate of 2% to 30. It is important to obtain supine and upright views.
 - Cocaine pack density is often (75%) same as soft tissues.
 - Packs ingested by body stuffers may not be visualized on plain radiographs.
 - Packs ingested by body packers have additional signs on plain radiographs, including several oval or oblong isodense packets, an air crescent (or double condom sign) due to air trapped in the wrapping of the packet (80%), and a "rosette" due to air trapped in the knot at the end of the packet (17%).
- CT: May be the only modality that can visualize the drug packs, which are typically seen as circular or sausage-shaped bundles of white opacities.
- Ultrasound: Ultrasound is of limited utility.
- MRI: MRI is unable to visualize the drug due to lack of or minimal water content.

- MRI: MRI is unable to visualize the drug due to lack of or minimal water content.

Clinical findings

- Leaking or rupture of ingested packs may cause cocaine toxicity and/or death (increased likelihood in body stuffers as packages are not carefully created/sealed).
- Other clinical risks include obstruction of the esophagus or small bowel (typically at ileocecal valve).
- Signs of leak/rupture include tachycardia (may progress to asystole), agitation, and euphoria.

Treatment

- Activated charcoal (adsorb toxins) is used if leakage or rupture is suspected.
- Laxatives or whole-bowel irrigation is performed if the individual is asymptomatic and the pack has not passed.
- Endoscopic manipulation is controversial due to the risk of pack rupture.
- Surgical intervention may be necessary if there are signs and symptoms of acute toxicity or intestinal obstruction.

References

1. Algra PR, Brogdon BG, Marugg RC. Role of radiology in a national initiative to interdict drug smuggling: The Dutch experience. *AJR Am J Roentgenol*. 2007;189(2):331-336.
2. Amon CA, Tate LG, Wright RK, Matusiak W. Sudden death due to ingestion of

History and MR images

Our appreciation is extended to Drs. Jeffrey Rudie and Erin Schwartz, University of Pennsylvania Department of Radiology, for contributing this case.

History: A 6-month-old boy presents with right lower extremity weakness, decreased reflexes, and decreased pain response. The patient also has a history of a recent fever and viral illness. Family history includes a brother with seizures, leading to cerebral edema and death.

An MRI scan of the spine was obtained. T2-weighted sagittal and axial images of the spine are shown below. Click to enlarge.

There is abnormal spinal cord signal.

☐ True

☐ False

The question above accounts for 12% of your total score for this case.

What is the **LEAST likely etiology?**

☐ Infectious

☐ Autoimmune

☐ Congenital

☐ Idiopathic

The question above accounts for 11% of your total score for this case.

There is abnormal spinal cord signal.

☒ True (correct!)

☐ False

The question above accounts for 12% of your total score for this case.

What is the **LEAST likely etiology?**

☐ Infectious

☐ Autoimmune

☒ Congenital (correct!)

☐ Idiopathic

The question above accounts for 11% of your total score for this case.

☐ Idiopathic

The question above accounts for 11% of your total score for this case.

What is the most appropriate treatment?

☐ Emergent surgery

☐ Antibiotics

☐ Steroids

☐ Observation

The question above accounts for 11% of your total score for this case.

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☐ Idiopathic

The question above accounts for 11% of your total score for this case.

What is the most appropriate treatment?

☐ Emergent surgery

☐ Antibiotics

☒ Steroids (correct!)

☐ Observation

The question above accounts for 11% of your total score for this case.

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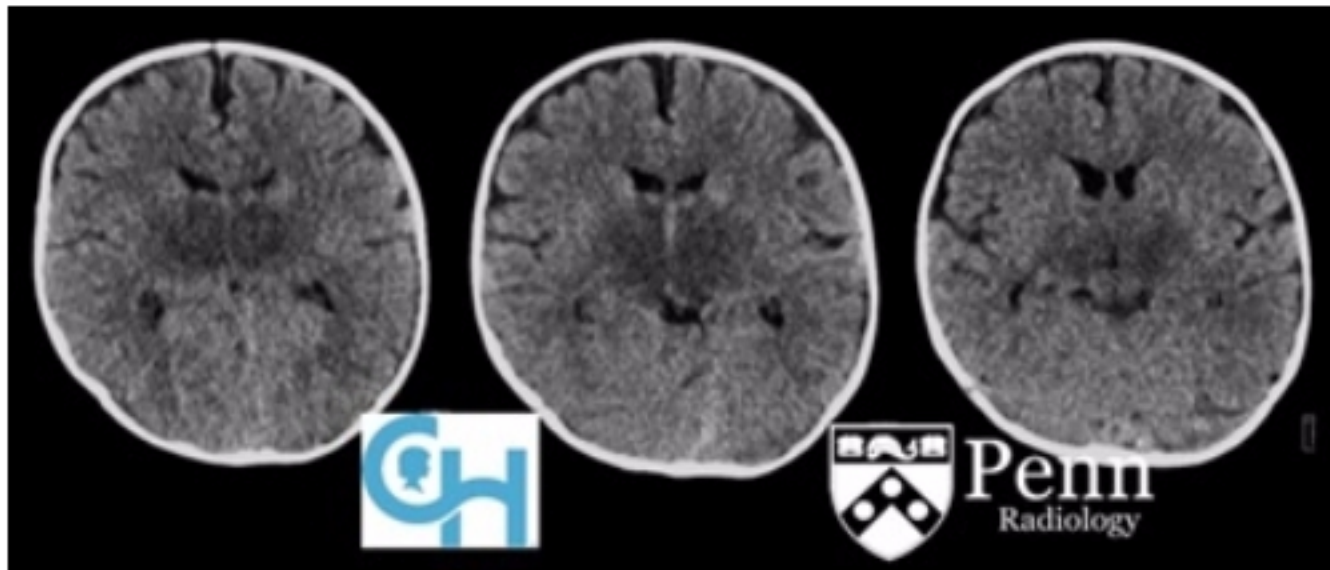
CASE OUTLINE

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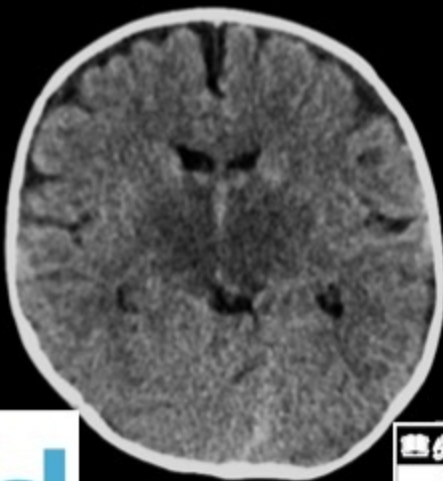
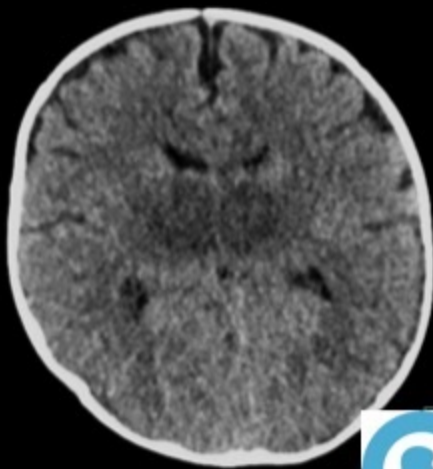
Additional history and CT images

The child was treated with steroids for presumed enterovirus-related inflammatory myelitis. One month later, the child developed new-onset seizures.

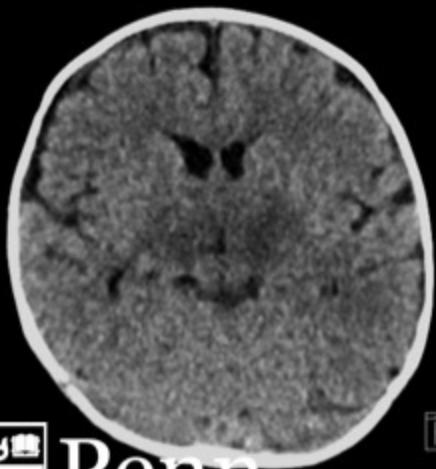
A noncontrast CT scan of the head was performed. Axial images in brain windows are shown below. Click to enlarge.



In which region is the area of abnormal signal attenuation centered?



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In which region is the area of abnormal signal attenuation centered?

☐ Caudate nuclei

☐ Putamina

☐ Thalami

☐ Insular cortices

The question above accounts for 11% of your total score for this case.

What is the next most appropriate diagnostic step?

☐ CT angiography of the head and neck

☐ MRI of the brain with and without contrast

☐ CT of the head with contrast

☐ MRI of the spine with and without contrast

In which region is the area of abnormal signal attenuation centered?

☐ Caudate nuclei

☐ Putamina

☒ Thalami (correct!)

☐ Insular cortices

The question above accounts for 11% of your total score for this case.

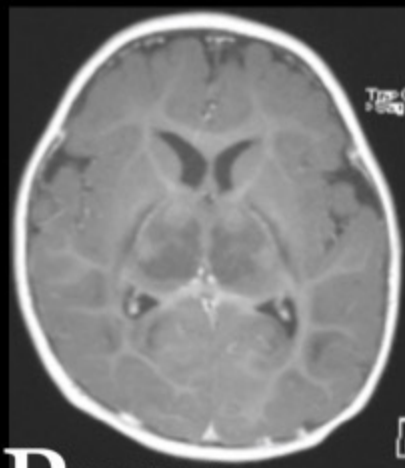
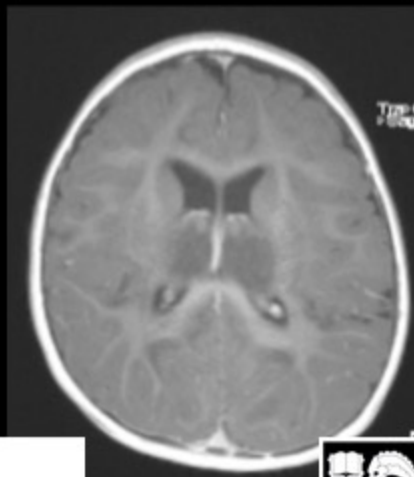
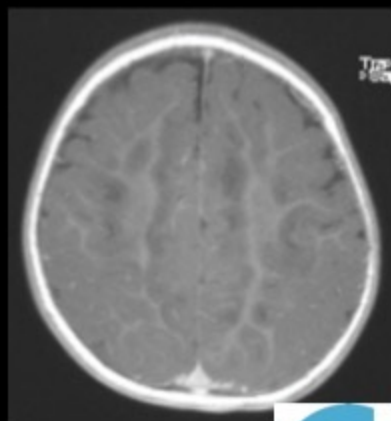
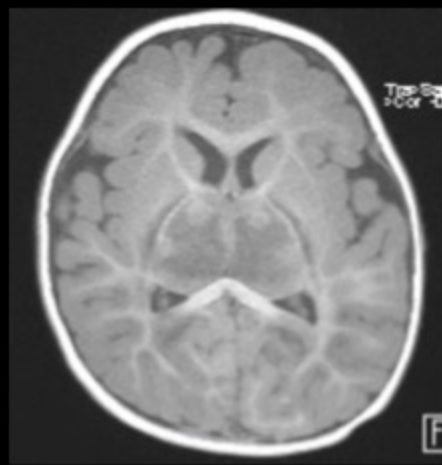
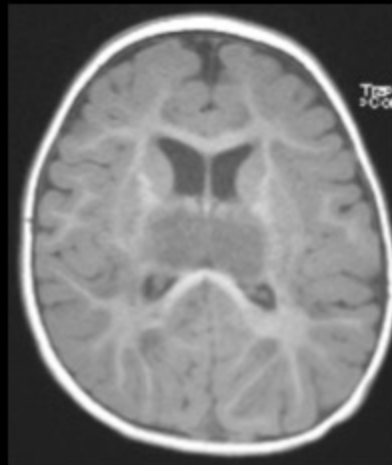
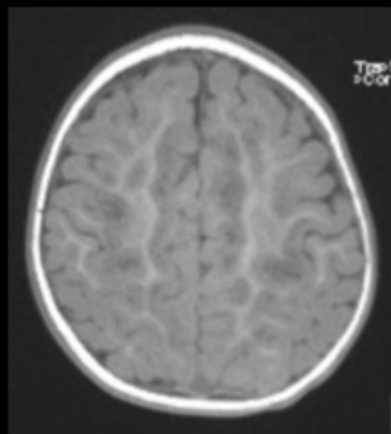
What is the next most appropriate diagnostic step?

☐ CT angiography of the head and neck

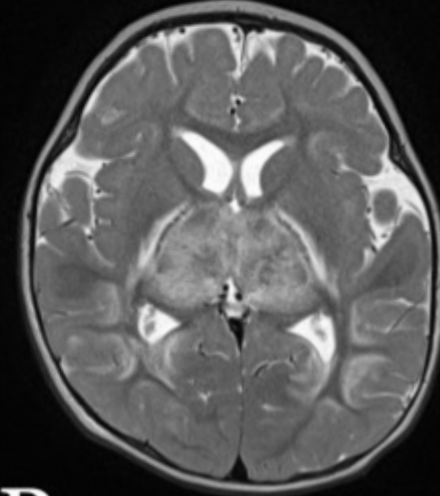
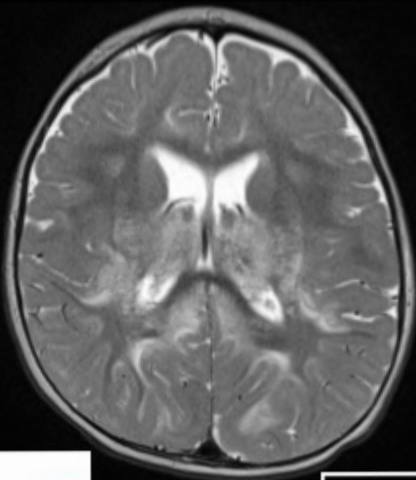
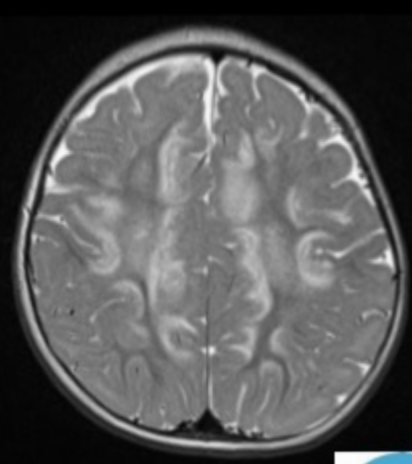
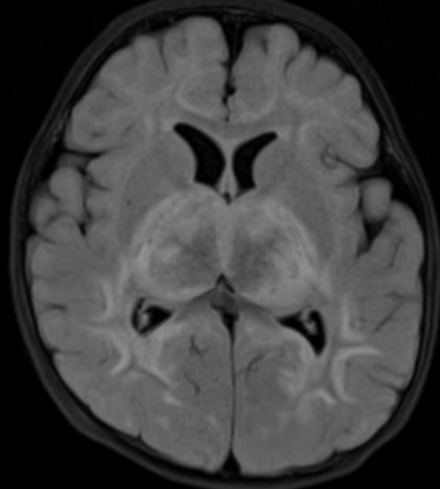
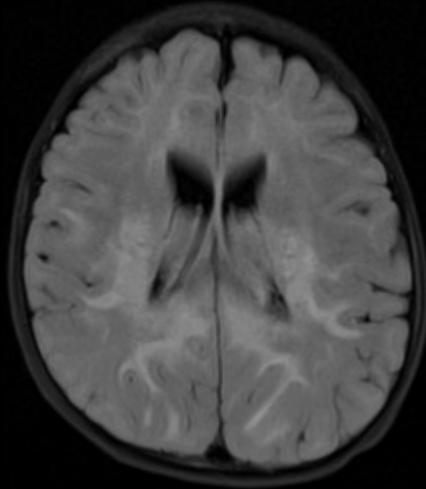
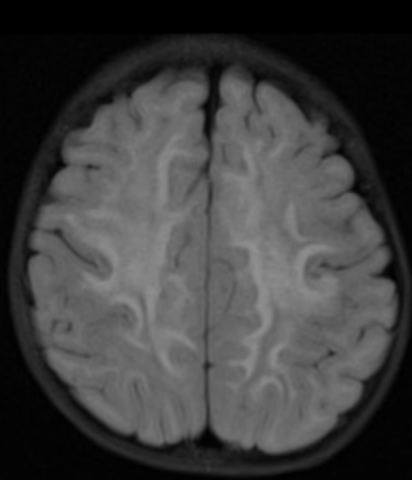
☒ MRI of the brain with and without contrast (correct!)

☐ CT of the head with contrast

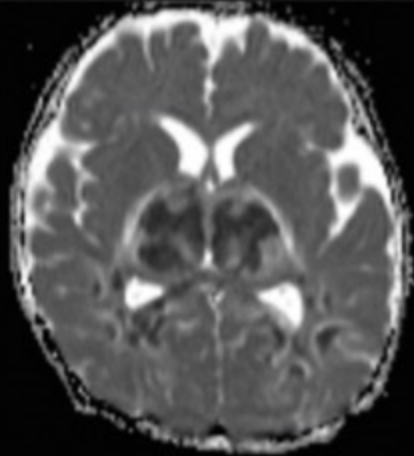
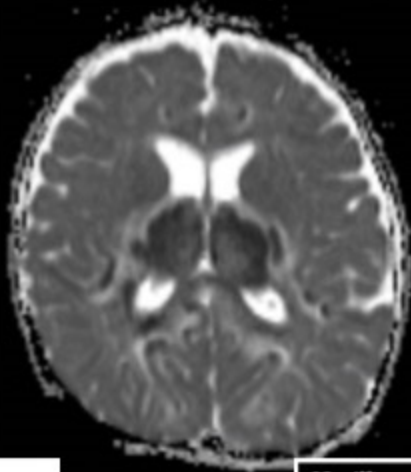
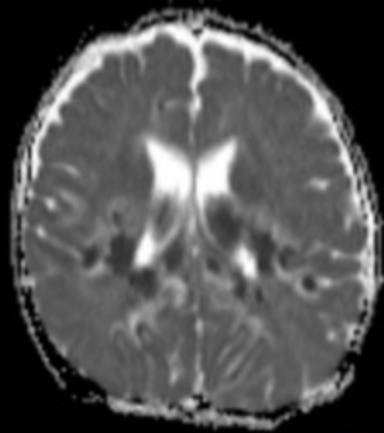
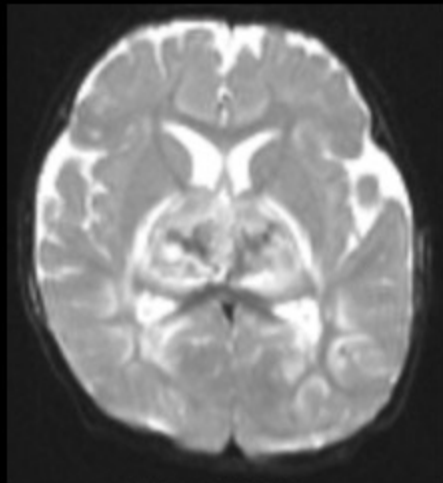
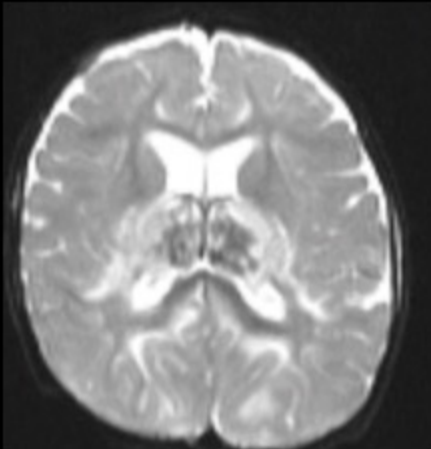
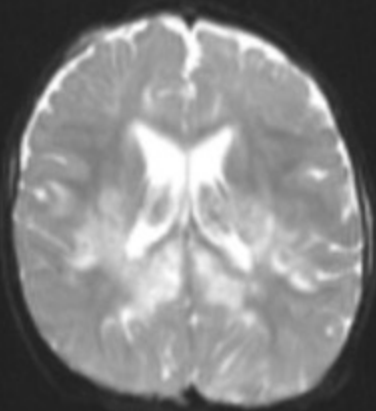
☐ MRI of the spine with and without contrast



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There is hemorrhage.

☐ True

☐ False

The question above accounts for 11% of your total score for this case.

There is restricted diffusion.

☐ True

☐ False

The question above accounts for 11% of your total score for this case.

What is the most likely etiology?

☐ Vascular hemorrhagic

☐ Vascular ischemic

☐ Autoimmune

☐ Bacterial

☐ Neoplastic

There is hemorrhage.

☒ True (correct!)

☐ False

The question above accounts for 11% of your total score for this case.

There is restricted diffusion.

☒ True (correct!)

☐ False

The question above accounts for 11% of your total score for this case.

What is the most likely etiology?

☐ Vascular hemorrhagic

☐ Vascular ischemic

☒ Autoimmune (correct!)

☐ Bacterial

☐ Neoplastic

The question above accounts for 11% of your total score for this case.

What is the most likely diagnosis?

☐ Artery of Percheron infarction

☐ Hypoxic-ischemic encephalopathy

☐ Acute necrotizing encephalitis of childhood

☐ Acute disseminated encephalomyelitis

☐ Reye's syndrome

☐ West Nile encephalitis

The question above accounts for 11% of your total score for this case.

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☐ Neoplastic

The question above accounts for 11% of your total score for this case.

What is the most likely diagnosis?

☐ Artery of Percheron infarction

☐ Hypoxic-ischemic encephalopathy

☒ Acute necrotizing encephalitis of childhood (correct!)

☐ Acute disseminated encephalomyelitis

☐ Reye's syndrome

☐ West Nile encephalitis

The question above accounts for 11% of your total score for this case.

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Findings

- **Initial spine MRI:** MRI demonstrates expansion and abnormal T2 prolongation in the lower thoracic spinal cord extending to the conus medullaris, which was without associated contrast enhancement (postcontrast imaging not shown). The imaging findings are suggestive of an inflammatory myelitis. Differential considerations include viral myelitis (possibly newer strains of enterovirus, noting that they more commonly involve the cervical spinal cord) and idiopathic transverse myelitis. Correlation with cerebrospinal fluid (CSF) sampling was recommended.
- **Head CT:** CT shows abnormal, symmetrical hypodensity and swelling of the bilateral thalami and parts of the adjacent basal ganglia. Diagnostic considerations include infectious processes, particularly viral encephalitis. Other less likely considerations include deep venous thrombosis with ischemia, metabolic disorders, and reactive demyelination.
- **Head MRI:** There are symmetric patchy areas of restricted diffusion with microhemorrhages involving the cortices of predominately the posterior portions of both cerebral hemispheres with increased diffusion within the regional subcortical and deep white matter. The thalami are markedly enlarged and demonstrate a mixed diffusion pattern, both increased (more centrally) and decreased (more peripherally) with associated T2 hyperintensity and significant susceptibility effect, the latter indicating microhemorrhages. Many of these areas of abnormal signal demonstrate patchy areas of contrast enhancement. The leading consideration is acute necrotizing encephalopathy of childhood. Metabolic disorders, such as mitochondrial disease, are additional considerations.

additional considerations.

Differential diagnosis

- Acute necrotizing encephalitis of childhood
- Acute hemorrhagic encephalomyelitis
- Acute disseminated encephalomyelitis
- Artery of Percheron infarction
- Hypoxic-ischemic encephalopathy
- Viral encephalitis
- Leigh syndrome
- Reye's syndrome
- Deep venous thrombosis with venous ischemia

Diagnosis: Acute necrotizing encephalitis of childhood

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Acute necrotizing encephalitis of childhood (ANEC)

Acute necrotizing encephalitis of childhood is a rare type of encephalopathy, with fewer than 150 reported cases, more commonly seen in individuals of Asian heritage. The clinical presentation classically consists of rapid onset of seizures, impaired consciousness, vomiting, and hepatic dysfunction in a young child, typically around the age of 4 years. This is often preceded by a viral illness, including influenza A/B, parainfluenza, varicella, or enterovirus.

The theorized etiology is an immune-mediated cytokine storm, with increased levels of tumor necrosis factor receptor-1 and various interleukins. Cytokine storms are associated with increased vascular permeability, disseminated intravascular coagulation, shock, and hemorrhage. It is distinct from inflammatory conditions such as acute disseminated encephalomyelitis (ADEM) or acute hemorrhagic encephalitis, as pathology will not show inflammatory cells.

Most cases are sporadic, but there have been reports of recurrence and/or familial

Most cases are sporadic, but there have been reports of recurrence and/or familial involvement (as in this case), suggestive of an underlying genetic predisposition. More recently, ANEC has been associated with defects in the RANBP2 gene, involved in energy transport within mitochondria.

Diagnosis

ANEC is considered a diagnosis of exclusion. Although the imaging findings are moderately specific, clinical history and laboratory markers are needed to exclude other conditions. Hypoxic-ischemic injury is generally preceded by a clinical history of a circulatory/hypoxic event. Leigh syndrome and Reye's syndrome are both commonly associated with hypoglycemia, hyperammonemia, and lactic acidosis. Like ANEC, ADEM usually follows an infectious course but generally will involve white matter to a larger extent, is pathologically associated with lymphocytic infiltration, and is not associated with hepatic dysfunction. Viral encephalidities also will show inflammatory cells, and viral DNA/RNA can often be detected in the CSF. ANEC is associated with elevated CSF protein without pleocytosis and elevated liver enzymes.

Imaging features

- Acute necrotizing encephalitis is characterized by multiple symmetrical lesions that invariably involve the thalami and the putamina/globi pallidi, cerebral and cerebellar white matter, brainstem, and tegmentum.
- On CT, affected areas will be hypodense.
- On MRI, affected areas are generally hypointense on T1-weighted images and hyperintense on T2-weighted and T2-weighted FLAIR images, often with restricted diffusion and patchy areas of postcontrast enhancement.
- The thalamic lesions often have a classic “triplanar look,” consisting of central hemorrhage, with surrounding layers of restricted diffusion and then increased diffusion/vasogenic edema.

Treatment and prognosis

- The prognosis is quite poor, with up to 60% mortality rate and severe neurologic sequela such as tremor, spasticity, ataxia, and speech impairments in the chronic

hemorrhage, with surrounding layers of restricted diffusion and then increased diffusion/vasogenic edema.

Treatment and prognosis

- The prognosis is quite poor, with up to 60% mortality rate and severe neurologic sequela such as tremor, spasticity, ataxia, and speech impairments in the chronic stages.
- The volume of brain involved, brainstem involvement, and presence of hemorrhage and/or cavitation are associated with worse outcomes.
- Treatment is largely supportive, including anticonvulsants, steroids, and mannitol.
- It is unclear whether antiviral drugs have any impact on outcome.

References

1. Gika AD, Rich P, Gupta S, Neilson DE, Clarke A. Recurrent acute necrotizing encephalopathy following influenza A in a genetically predisposed family. *Dev Med*

History and CT images

Our appreciation is extended to Dr. Teresa Martin-Carreras, University of Pennsylvania Department of Radiology, for contributing this case.

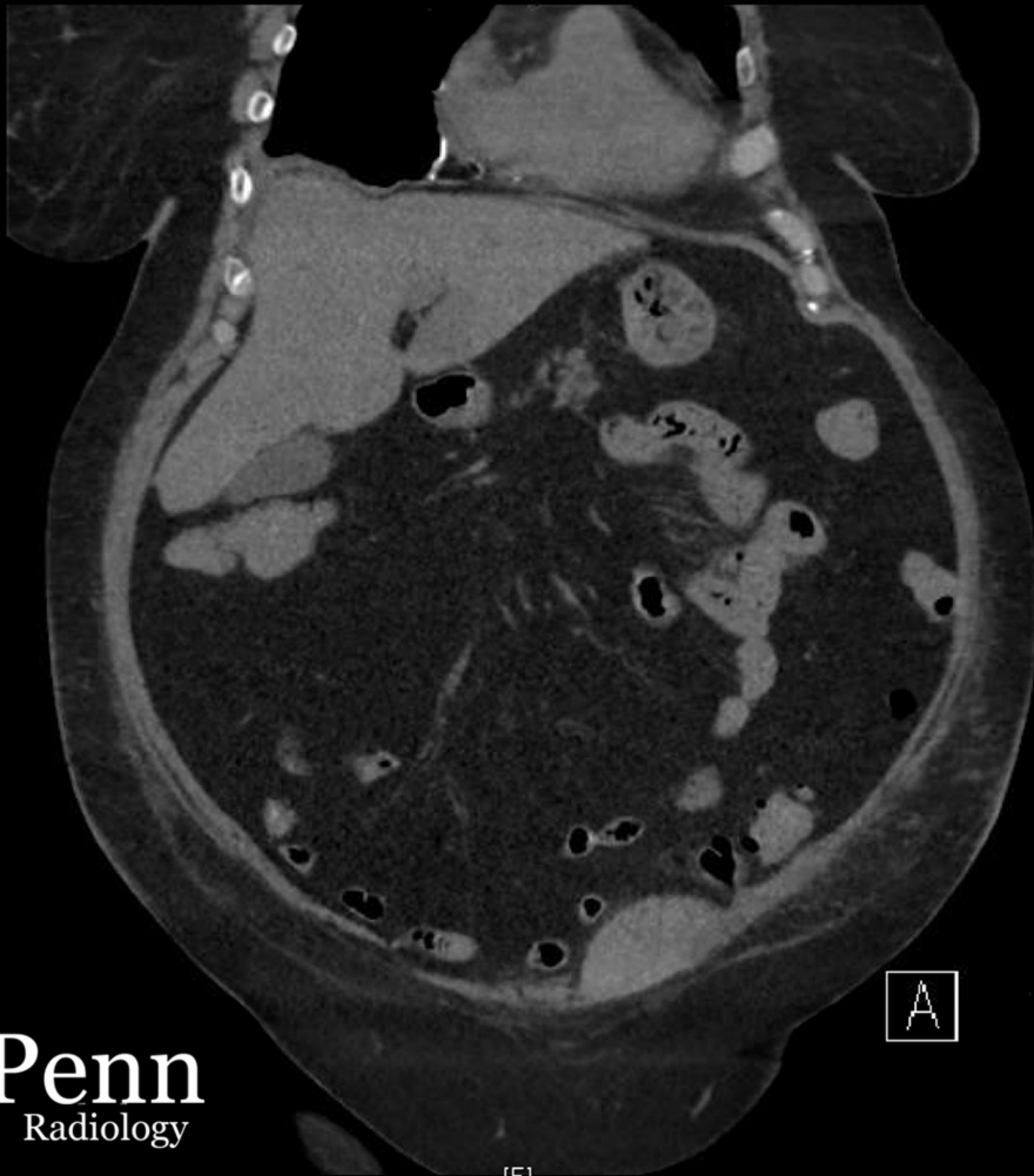
History: A 68-year-old woman admitted for treatment of pulmonary embolus with anticoagulation develops sudden-onset, acute left lower quadrant abdominal pain. The patient's hemoglobin levels are found to be dropping significantly on laboratory workup.

A CT scan of the abdomen and pelvis was obtained for further evaluation. Axial, coronal, and sagittal reformatted images are shown below. Click images to enlarge.



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[H]

L

[E]

The salient finding is a normal anatomic variant.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

The salient finding likely represents sequela of remote surgery.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

Which of the following physical exam signs is most likely to be found in this patient?

☐ Bancroft's sign

☐ Battle's sign

☐ Fothergill's sign

☐ Kehr's sign

The salient finding is a normal anatomic variant.

☐ True

☒ False (correct!)

The question above accounts for 16% of your total score for this case.

The salient finding likely represents sequela of remote surgery.

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Which of the following physical exam signs is most likely to be found in this patient?

☐ Bancroft's sign

☐ Battle's sign

☒ Fothergill's sign (correct!)

☐ Kehr's sign

What is the most likely diagnosis?

☒ Rectus sheath hematoma

☐ Abdominal wall neoplasm

☐ Abdominal wall abscess

☐ Intra-abdominal neoplasm

The question above accounts for 16% of your total score for this case.

[VIEW YOUR SCORE](#)

1

2

3

4

[next »](#)

What is the most likely diagnosis?

☒ Rectus sheath hematoma (correct!)

☐ Abdominal wall neoplasm

☐ Abdominal wall abscess

☐ Intra-abdominal neoplasm

The question above accounts for 16% of your total score for this case.

[VIEW YOUR SCORE](#)

1

2

3

4

[next »](#)



Findings

There is a high-attenuation collection tracking within the left rectus sheath with attenuation measuring up to 54.7 Hounsfield units. This collection measures approximately 6.8 x 3.9 x 15.0 cm. There is associated fat stranding about this collection along the subcutaneous soft tissues of the anterior left lower abdominal wall and left lower pelvis.

Differential diagnosis

- Abdominal wall neoplasm
- Abdominal wall abscess
- Intra-abdominal neoplasm

Diagnosis: Left rectus sheath hematoma

68-year-old woman with acute abdominal pain

CASE OUTLINE

Page 3 of 4

Additional questions

Rectus sheath hematoma is most common in women.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

It is most commonly managed conservatively.

☐ True

☐ False

68-year-old woman with acute abdominal pain

CASE OUTLINE

Page 3 of 4

Additional questions

Rectus sheath hematoma is most common in women.

☒ True (correct!)

☐ False

The question above accounts for 16% of your total score for this case.

It is most commonly managed conservatively.

☒ True (correct!)

☐ False

Key points

Rectus sheath hematoma (RSH)

Pathophysiology

- Rectus sheath hematoma refers to a hematoma that forms in the rectus muscle/rectus sheath.
- It most commonly occurs along the lower segments of the muscle and is more common in the right lower quadrant.
- It is classified into three different grades at CT:
 - Grade I: Mild RSH that is intramuscular, unilateral, and does not dissect along fascia adjacent to the rectus muscle.
 - Grade II: Moderate RSH that is intramuscular, dissects along adjacent fascia, and may involve bilateral rectus muscles but without extension into the prevesical space.
 - Grade III: Severe RSH that dissects along the fascia, and extends into the peritoneum and the prevesical space.
- Mortality risk is 4% overall, but it can be as high as 25% in patients on anticoagulation. Higher mortality rates have also been documented in pregnant women.
- Typically, it is the result of a rupture of the epigastric vessels or tearing of the abdominal fibers of the rectus abdominis muscle.
 - RSH above the arcuate line is generally caused by damage to the superior epigastric artery.
 - Appears as a unilateral, spindle-shaped mass.
 - Typically, it is self-limited, because the hematoma is tamponaded between the rectus sheath and the tendinous inscriptions of the rectus muscles.
 - RSH below the arcuate line is caused by damage to the inferior epigastric artery.
 - There is more profuse bleeding.
 - Dissection of tissue planes and extension across the midline may be seen due to the absence of a tendinous posterior sheath wall in this area. Instead, the rectus muscle is supported only by the transversalis fascia and the parietal peritoneum in this region.
 - It most commonly occurs in the setting of anticoagulation.
 - It may also be seen in the settings of trauma, coagulopathies, strenuous exercise, degenerative vascular diseases, or iatrogenic from a high femoral arterial puncture.

Epidemiology

- Rectus sheath hematoma is more common in women, with a M:F ratio of 1:3.
- It occurs most commonly around 50 to 60 years of age.
- It accounts for 1.5% to 2% of cases of unexplained abdominal pain.
- Incidence of RSH is increasing as more elderly patients are being treated with antiplatelet and anticoagulant therapies.

Clinical presentation

- The most common presenting symptom is acute abdominal pain that may be associated with a palpable abdominal mass.
 - Pain is typically unilateral.
 - Pain is made worse with movement.
- Patients may also have fever, nausea, vomiting, and symptoms of hypovolemic shock.
- On laboratory workup, declining hemoglobin levels are often seen.
- Fothergill's, Carnett's, Cullen's, and/or Grey Turner's signs may be seen on clinical examination.
 - Fothergill's sign: Refers to an abdominal mass that does not cross midline and does not change with flexion of the rectus muscles.
 - Carnett's sign: Refers to unchanged or increased abdominal pain with tension of the abdominal wall muscles, typically elicited by raising the head or leg.
 - Cullen's sign: Refers to superficial edema with bruising in the periumbilical subcutaneous fatty tissues.
 - Grey Turner's sign: Refers to bruising of the flanks.

Imaging features

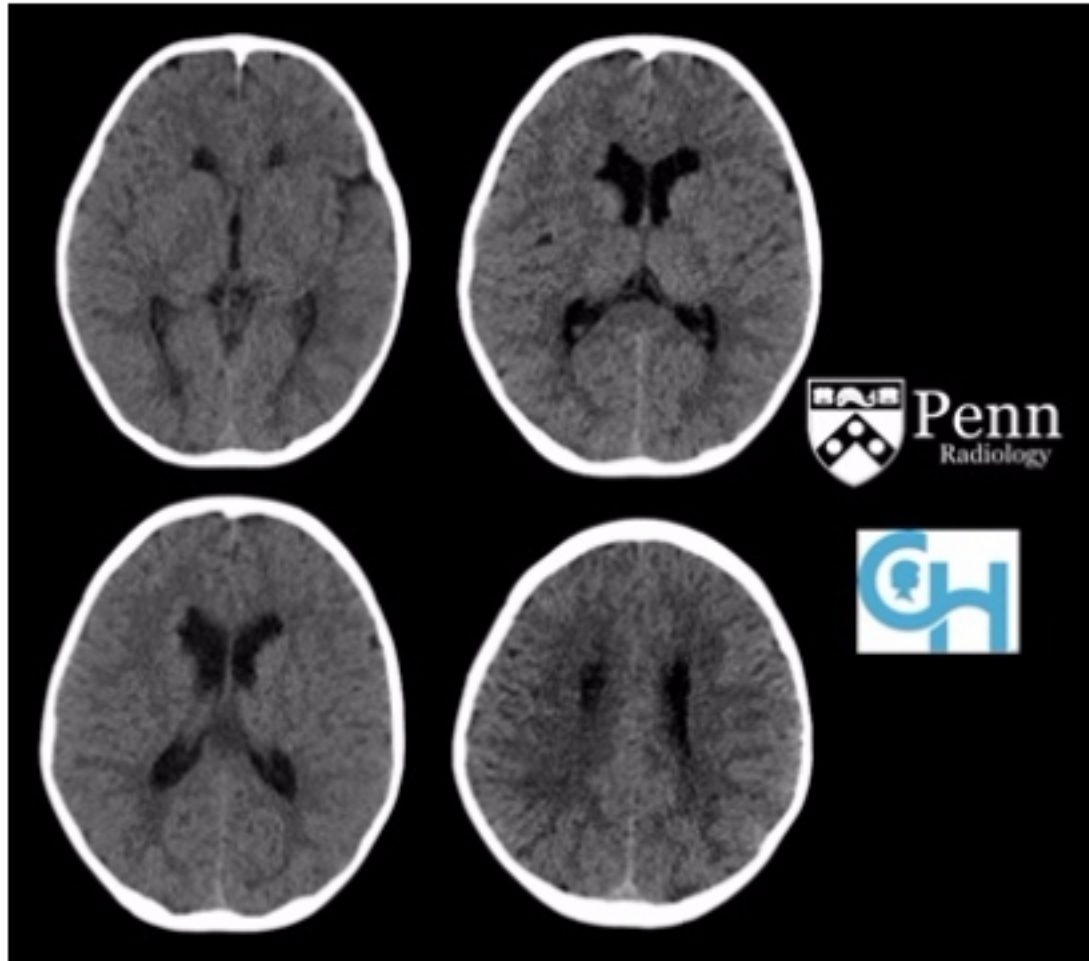
- Ultrasound:
 - Appears as a heterogeneous superficial mass, often spindle-shaped on longitudinal scanning and ovoid on transverse scanning.
 - It may be multilocular and septated with internal echoes.
- CT
 - A hematoma is seen involving the anterior abdominal wall.
 - Appears hyperdense on unenhanced images.
 - No enhancement is seen.

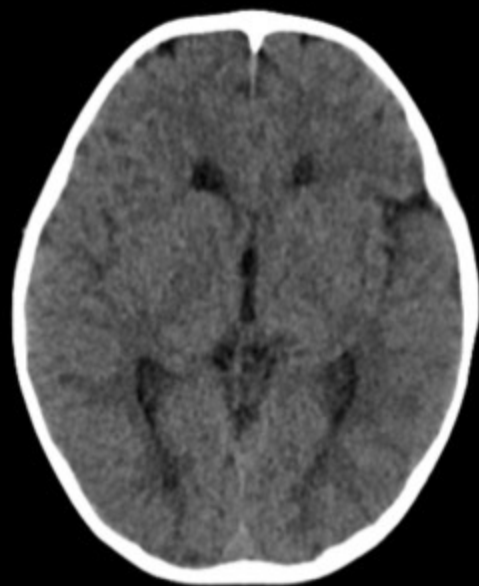
Treatment

- Rectus sheath hematoma is typically managed conservatively with intravenous fluid resuscitation, pain management, withholding of anticoagulation, and a gradual increase in activity.
- Spontaneous resolution may take up several months.
- Some cases may require reversal of anticoagulation and/or transfusion of blood products to optimize hemodynamic stability.
- In patients with refractory bleeding despite reversal of coagulopathy, coil or gel foam embolization of the bleeding epigastric vessels may be beneficial.

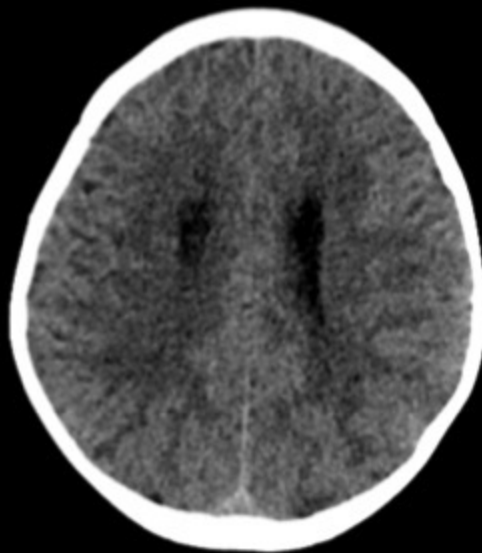
History: An 18-month-old boy presents with febrile seizures and staring spells.

A CT scan of the head was performed. Axial slices in soft-tissue window are shown below.
Click to enlarge.





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The ventricles have a dysmorphic appearance.

☐ True

☐ False

The question above accounts for 16% of your total score for this case.

What is the next most appropriate step for a more definitive evaluation?

☐ Brain MRI

☐ CT angiography

☐ Head CT with contrast

☐ Cerebral angiography

The ventricles have a dysmorphic appearance.

☒ True (correct!)

☐ False

The question above accounts for 16% of your total score for this case.

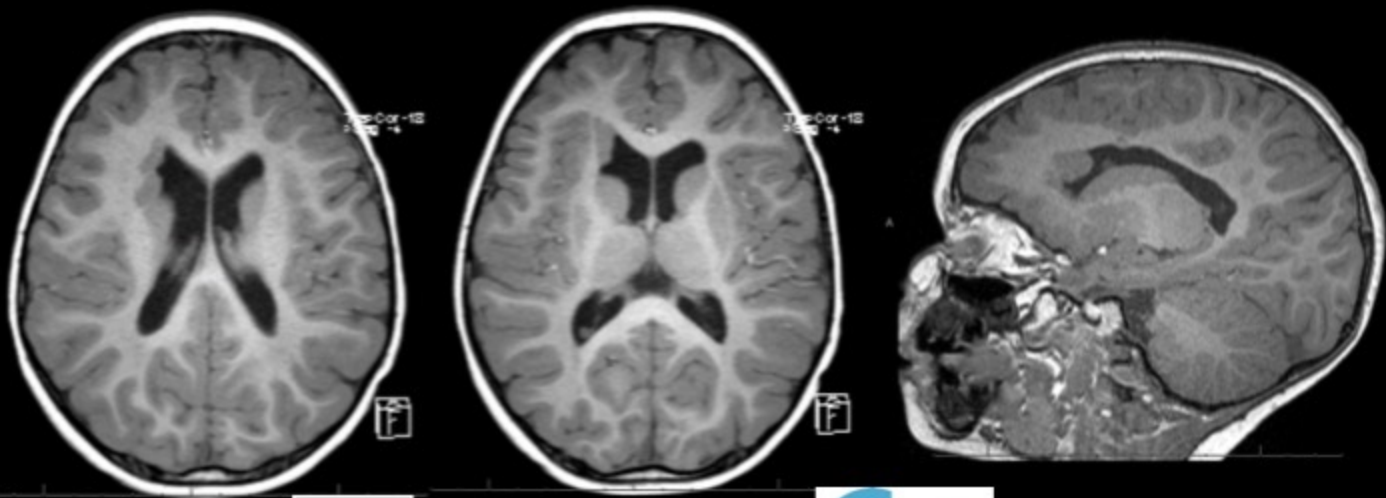
What is the next most appropriate step for a more definitive evaluation?

☒ Brain MRI (correct!)

☐ CT angiography

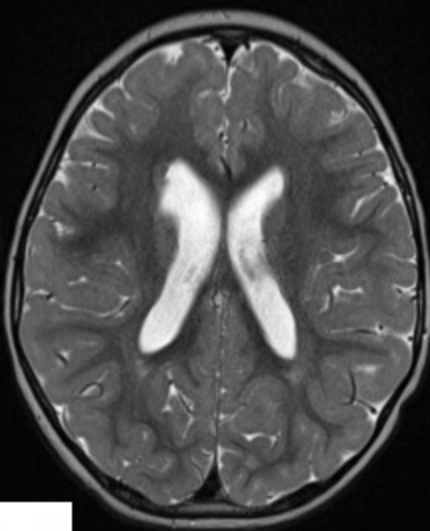
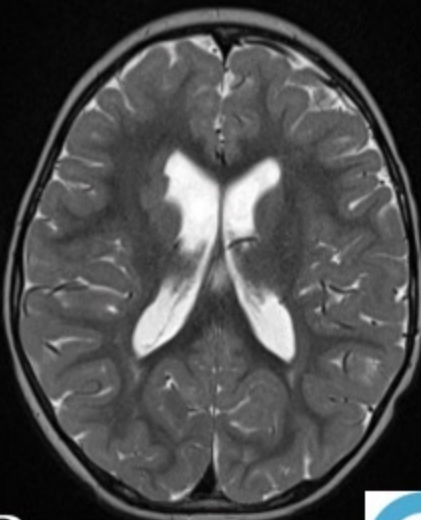
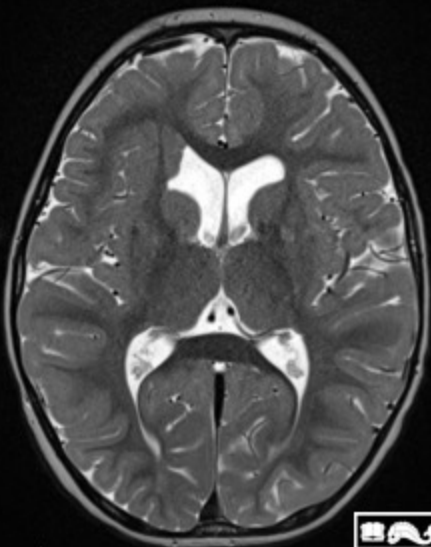
☐ Head CT with contrast

☐ Cerebral angiography

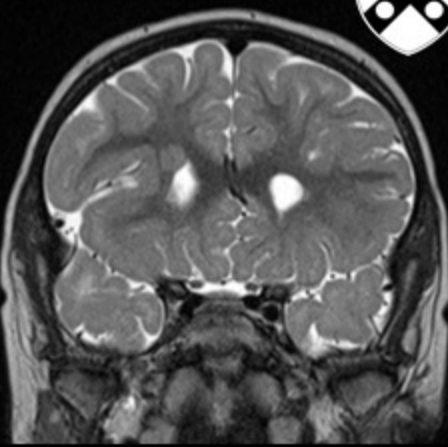


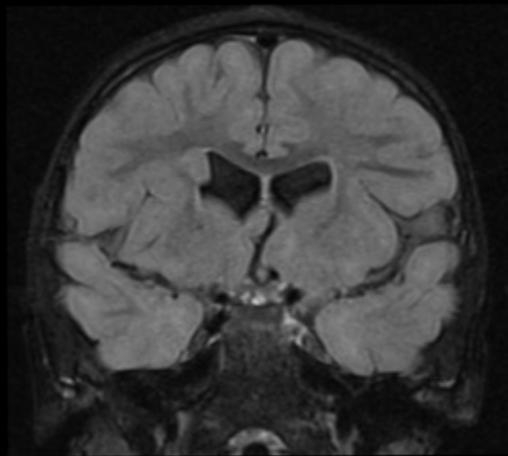
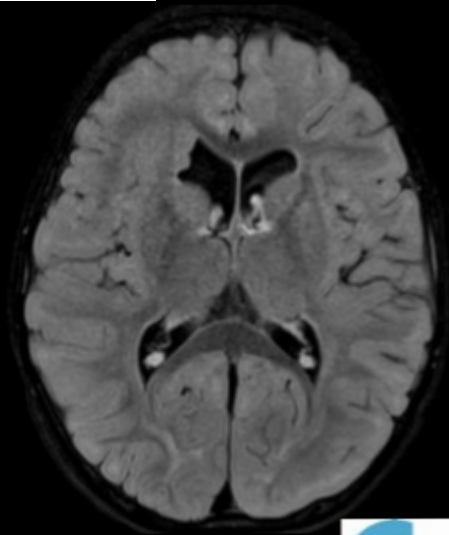
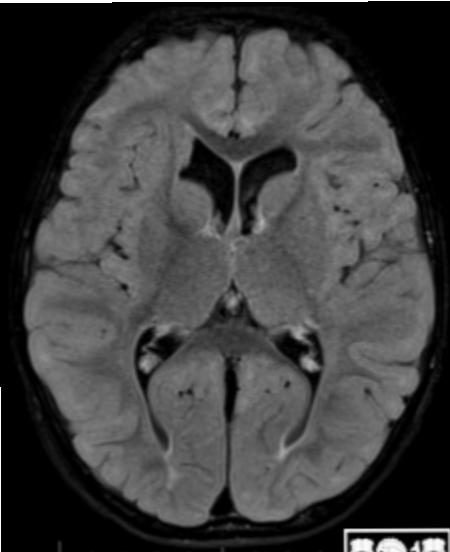
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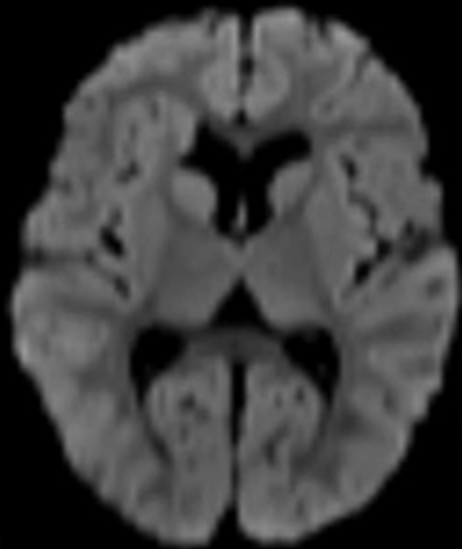
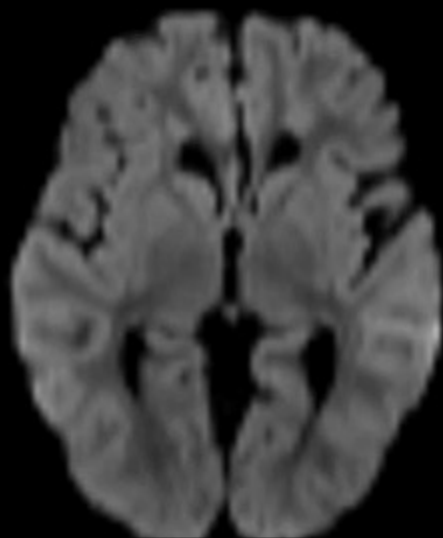
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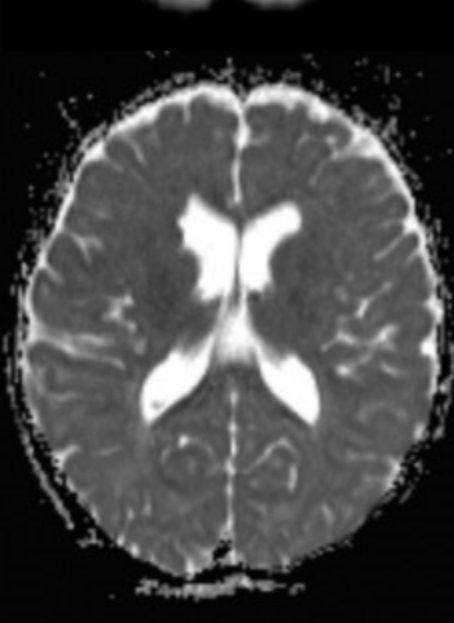
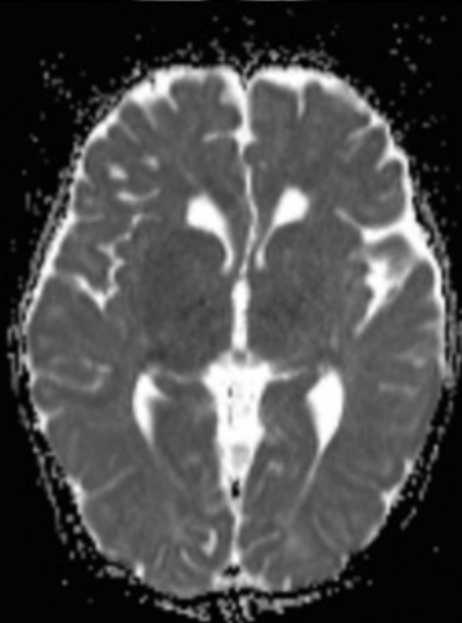


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Where is the abnormality?

- ☐ Periventricular white matter adjacent to the frontal horn of the left lateral ventricle
- ☐ Periventricular white matter adjacent to the frontal horn of the right lateral ventricle
- ☐ Periventricular white matter adjacent to the occipital horn of the left lateral ventricle
- ☐ Periventricular white matter adjacent to the occipital horn of the right lateral ventricle

The question above accounts for 17% of your total score for this case.

There is abnormal restricted diffusion.

- ☐ True
- ☐ False

Where is the abnormality?

- ☐ Periventricular white matter adjacent to the frontal horn of the left lateral ventricle
- ☒ Periventricular white matter adjacent to the frontal horn of the right lateral ventricle (correct!)
- ☐ Periventricular white matter adjacent to the occipital horn of the left lateral ventricle
- ☐ Periventricular white matter adjacent to the occipital horn of the right lateral ventricle

The question above accounts for 17% of your total score for this case.

There is abnormal restricted diffusion.

- ☐ True
- ☒ False (correct!)

What is the most likely etiology of the lesions?

☐ Autoimmune

☐ Developmental/congenital

☐ Infectious

☐ Neoplastic

☐ Vascular

The question above accounts for 17% of your total score for this case.

What is the most likely diagnosis?

☐ Cortical tubers in tuberous sclerosis

☐ Focal cortical dysplasia

☐ Subcortical gray-matter heterotopia

☐ Subependymal (periventricular) gray-matter heterotopia

☐ Subependymal hemorrhage

What is the most likely etiology of the lesions?

☐ Autoimmune

☒ Developmental/congenital (correct!)

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What is the most likely diagnosis?

☐ Cortical tubers in tuberous sclerosis

☐ Focal cortical dysplasia

☐ Subcortical gray-matter heterotopia

☒ Subependymal (periventricular) gray-matter heterotopia (correct!)

☐ Subependymal hemorrhage



Findings

- **Head CT:** There is a dysmorphic ventricular configuration with abnormal signal in the right periventricular white matter adjacent to the caudate. There is no acute hemorrhage, hydrocephalus, mass effect, or midline shift.
- **Brain MRI:** Multiple nodular foci with signal intensity isointense to gray matter are noted along the wall of the frontal horn of the right lateral ventricle with associated dysmorphic and mildly prominent configuration of the right frontal horn. There is no acute intracranial hemorrhage, abnormal fluid collection, or hydrocephalus.

Differential diagnosis

- Subependymal (periventricular) gray-matter heterotopia
- Subcortical gray-matter heterotopia
- Focal cortical dysplasia
- Band heterotopia
- Subependymal tubers of tuberous sclerosis
- Subependymal hemorrhage
- Polymicrogyria

Diagnosis: Subependymal (periventricular) gray-matter heterotopia

Discussion

Subependymal gray-matter heterotopia (periventricular nodular heterotopia)

Epidemiology and pathogenesis

Gray-matter heterotopia is a group of conditions caused by an interruption of the normal neuronal migration near the ventricle to the cortex during the prenatal period. Genetic defects in structural proteins necessary for radial migration as well as focal insults during in utero development have been implicated. Most cases are sporadic, although some are X-linked recessive, associated with the filamin-1 protein that cross links intracellular actin. X-linked cases in males usually have a more early and severe presentation, often with additionally associated anomalies.

The two major forms are nodular heterotopias and diffuse heterotopias (band heterotopia, lissencephaly and laminar heterotopia). Nodular heterotopias include subependymal (periventricular) heterotopia and subcortical heterotopia. Subependymal heterotopia (also known as periventricular heterotopia) is the most common form and is characterized by gray-matter nodules beneath the ependyma of the lateral ventricles. It can be unilateral focal, bilateral focal, and bilateral diffuse. It is most commonly seen on the right side due to later migration on the right compared with the left. The nodules consist of clusters of neurons and supporting glial cells.

Clinical presentation

right compared with the left. The nodules consist of clusters of neurons and supporting glial cells.

Clinical presentation

Patients most often present with partial seizures in the second decade of life. There is also a correlation with developmental delay and mental retardation.

Imaging features

- The classic finding of abnormal gray matter in the periventricular region is often faintly visualized on CT and rarely visible on ultrasound.
- MRI is the preferred imaging modality, which will show small oval or round nodules of gray matter deep in the ependymal layer, elevating and distorting the outlines of the ventricles.
- The heterotopic gray matter is often found in the frontal and occipital horns, as well as trigone.
- It is often bilateral but is more common on the right.
- The nodules will follow gray matter on all other sequences and will not enhance or show restricted diffusion.
- The patient must be evaluated for other associated abnormalities, which include polymicrogyria, pachygyria, agenesis of the corpus callosum, schizencephaly, Chiari II malformations, arachnoid cysts, and cephaloceles.

Treatment and prognosis

- Treatment is usually with medical control of epilepsy.

Treatment and prognosis

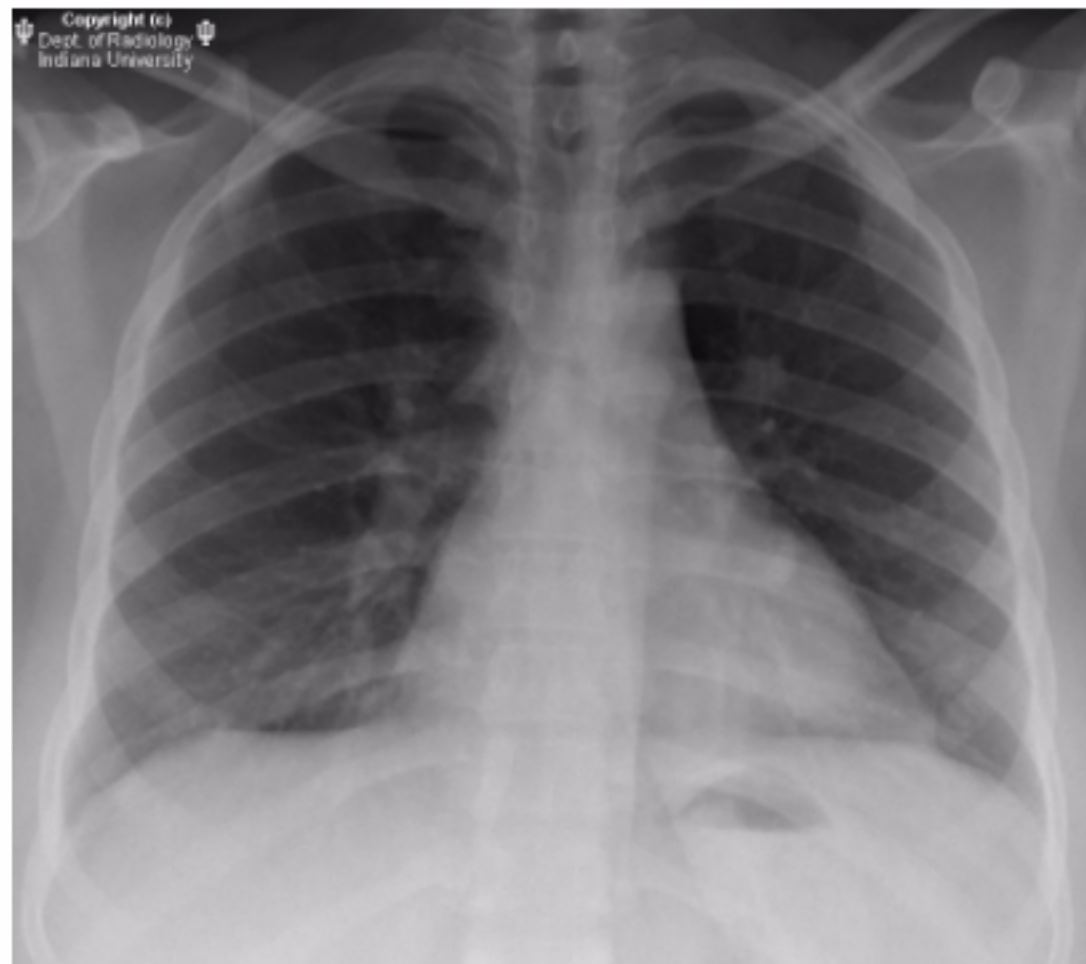
- Treatment is usually with medical control of epilepsy.
- Patients do not usually progress, but surgery to remove the areas of heterotopia causing epilepsy may be necessary in cases that are refractory to medication.
- Appropriate medical and neurobehavioral treatment for associated developmental delay and intellectual disability also are needed.

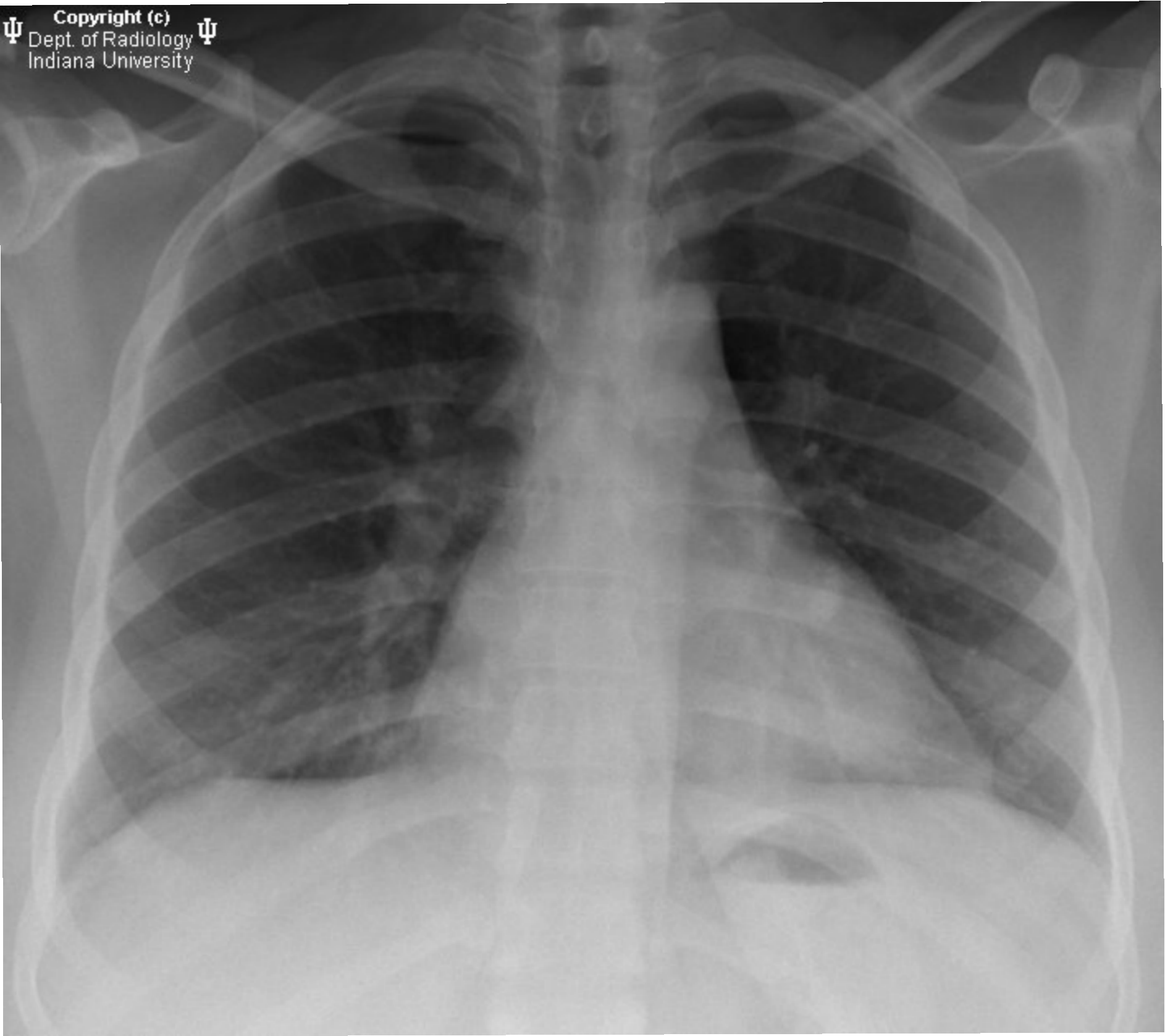
References

1. Abdel Razek AAK Kandell AY, Elsorogy LG, Elmongy A, Basett AA. Disorders of cortical formation: MR imaging features. *AJNR Am J Neuroradiol*. 2009;30(1):4-11.
2. Barkovich JA, Kjos BO. Gray matter heterotopias: MR characteristics and correlation with developmental and neurologic manifestations. *Radiology*. 1992;182(2):493-499.
3. Carlos Santos A, Escorsi-Rosset S, Simao GN, et al. Hemispheric dysplasia and hemimegalencephaly: Imaging definitions. *Childs Nerv Syst*. 2014;30(11):1813-1821.
4. Yang E, Chu WCW, Lee EY. A practical approach to supratentorial brain malformations what radiologists should know. *Radiol Clin N Am*. 2017;55(4):609-627.

History: A woman presents with dyspnea. She has a history of pulmonary embolism.

Chest radiograph is shown below. Click to enlarge.





Which of the following best characterizes the finding(s)?

☒ Peripheral consolidation

☐ Pleural effusion

☐ Pulmonary artery hypertension

☐ Westermark sign

☐ No acute abnormality

Which of the following best characterizes the finding(s)?

☐ Peripheral consolidation

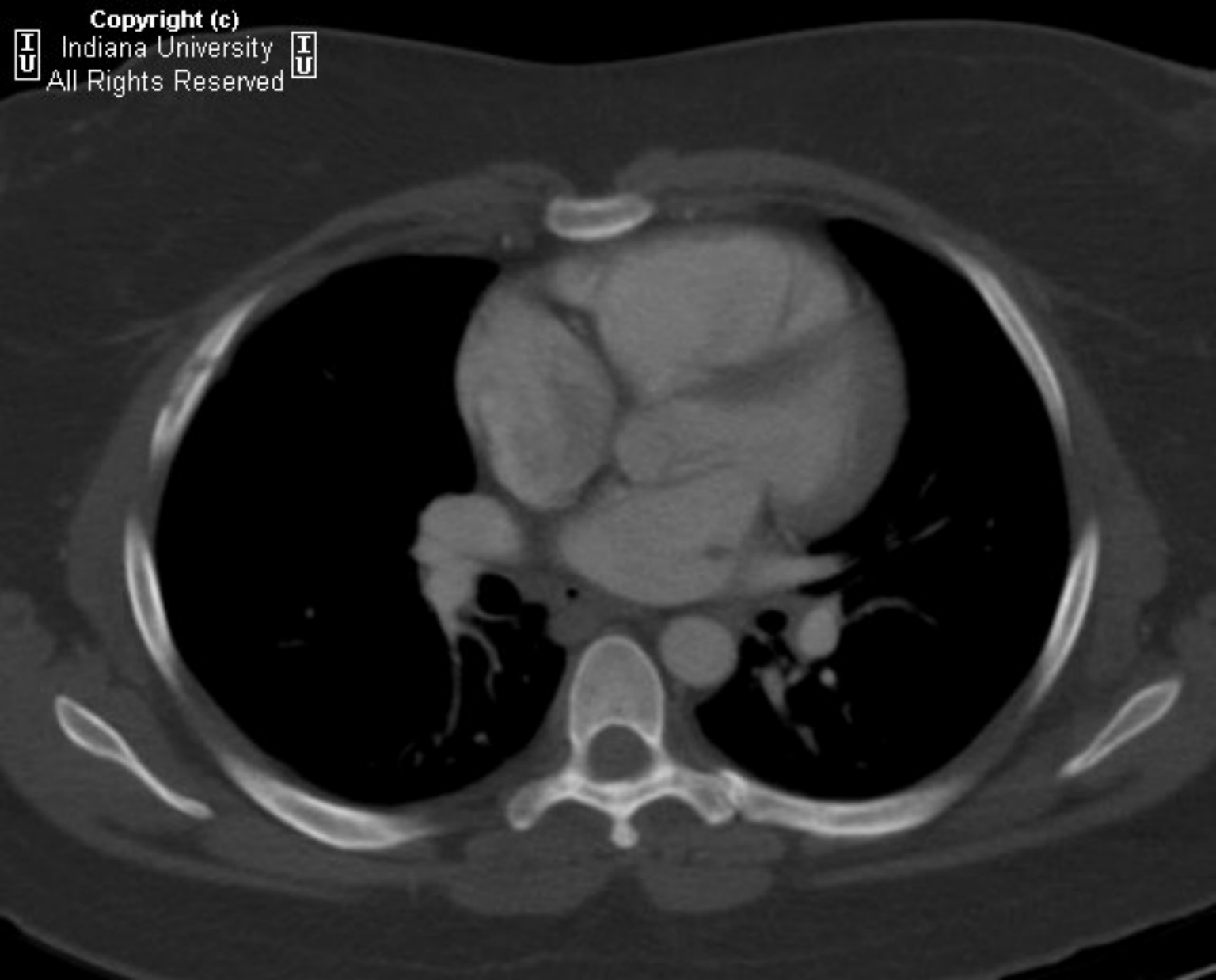
☐ Pleural effusion

☐ Pulmonary artery hypertension

☐ Westermark sign

☒ No acute abnormality (correct!)





Which choice best characterizes the salient abnormality, if one is visible?

☐ Unilateral pulmonary embolism

☐ Bilateral pulmonary embolism

☐ Right atrial thrombus

☐ Pericardial mass

☐ Chest wall lesion

Which choice best characterizes the salient abnormality, if one is visible?

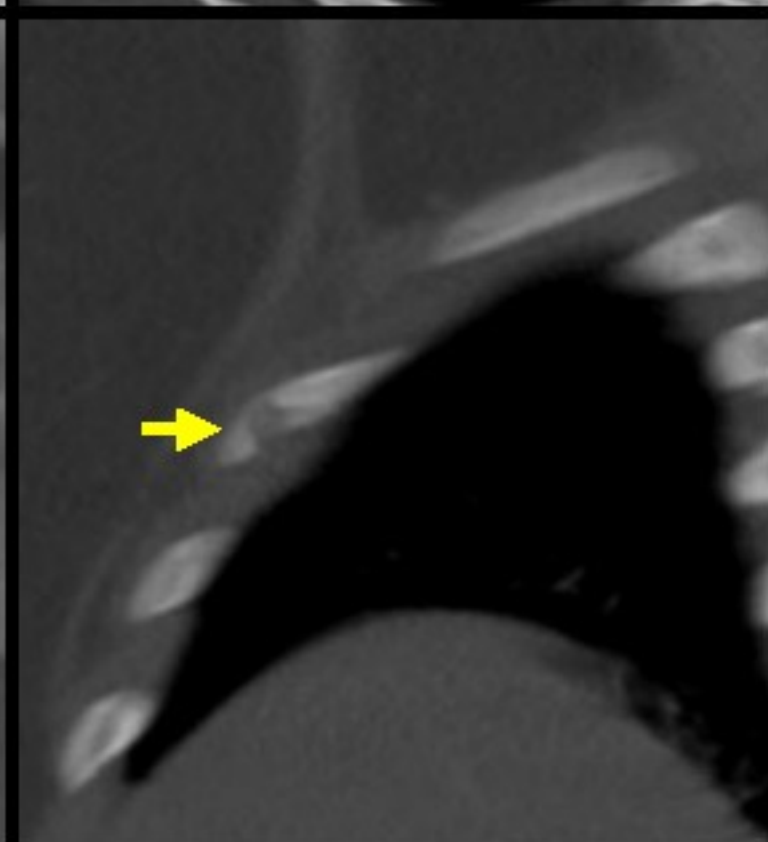
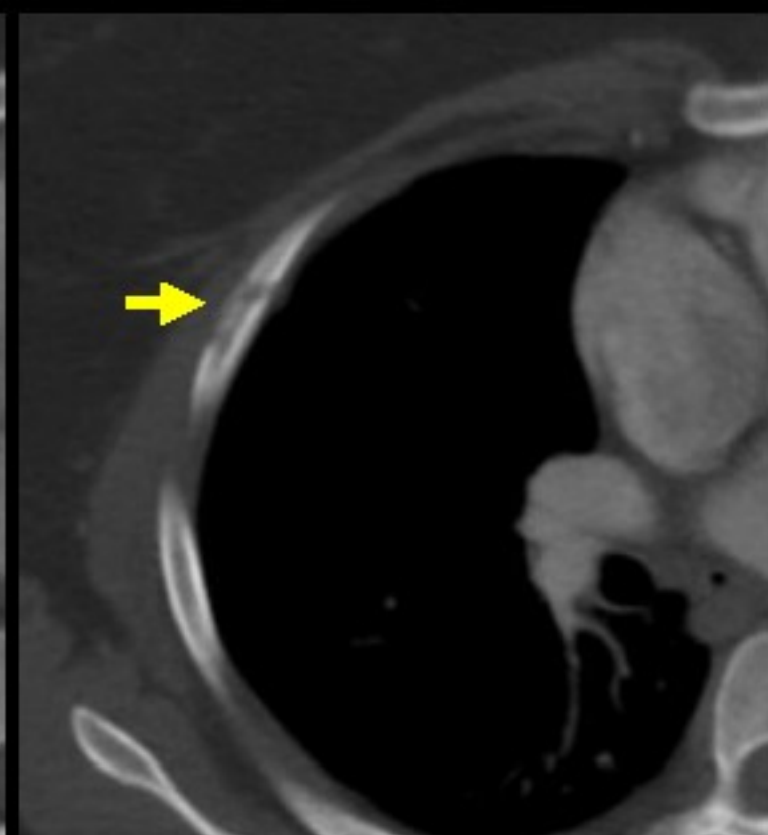
☐ Unilateral pulmonary embolism

☐ Bilateral pulmonary embolism

☐ Right atrial thrombus

☐ Pericardial mass

☒ Chest wall lesion (correct!)





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What is the diagnosis?

☐ Eosinophilic granuloma

☐ Osteomyelitis

☐ Lymphoma

☐ Fibrous dysplasia

☐ Plasmacytoma

What is the diagnosis?

☒ Eosinophilic granuloma (correct!)

☐ Osteomyelitis

☐ Lymphoma

☐ Fibrous dysplasia

☐ Plasmacytoma

Findings

Anteroposterior chest x-ray shows no acute cardiopulmonary abnormality. CT shows a right fourth rib lytic/destructive lesion. Bone scan shows a solitary, nonspecific focus of increased methylene diphosphonate (MDP) uptake in the right fourth rib.

Differential diagnosis

- Metastatic disease
- Eosinophilic granuloma
- Hemangioma
- Ewing's sarcoma
- Osteomyelitis
- Lymphoma

Diagnosis: Eosinophilic granuloma of the rib

Key points

Eosinophilic granuloma (EG)

- Langerhans cell histiocytosis is a group of disorders characterized by Langerhans cell proliferation. Eosinophilic granuloma is the mildest form of Langerhans cell histiocytosis (70%) with only bone involvement. The other two forms are listed below:
 - Letterer-Siwe disease (acute disseminated) -- 10%
 - Hand-Schüller-Christian disease (chronic disseminated) -- 20%
- The condition is relatively rare: Comprises 1% of biopsied primary bone tumors.
- Common locations include the flat bones (70%), long bones (30%), and spine (9%).
- It is monostotic in 50% to 75% of cases and multifocal in 10% to 20% of cases.
- Patients can present with local pain and swelling.
- 80% of patients are younger than age 30, and it is more common in males than females (M:F = 2:1).
- It has a benign course with spontaneous remission within three months to two years.
- Patients usually have no recurrence.

- Patients usually have no recurrence.
- Imaging findings:
 - The best imaging clue is a well-defined lytic lesion (punched out) without a sclerotic rim.
 - Langerhans cell histiocytosis is a "great imitator" of various benign and malignant bone lesions.
 - CT characteristics include a periosteal reaction, reactive sclerosis, and a beveled edge.
 - MRI: The lesion has a low T1 signal and high T2 signal, shows marked contrast enhancement, and appears destructive with surrounding edema.
 - Bone scan: The majority of lesions show increased uptake (normal uptake 35%) or decreased uptake with a halo of increased uptake.
- Treatment includes the following:
 - Observation
 - Bone graft for bone lesions at risk for pathological fracture
 - Steroid injections

References